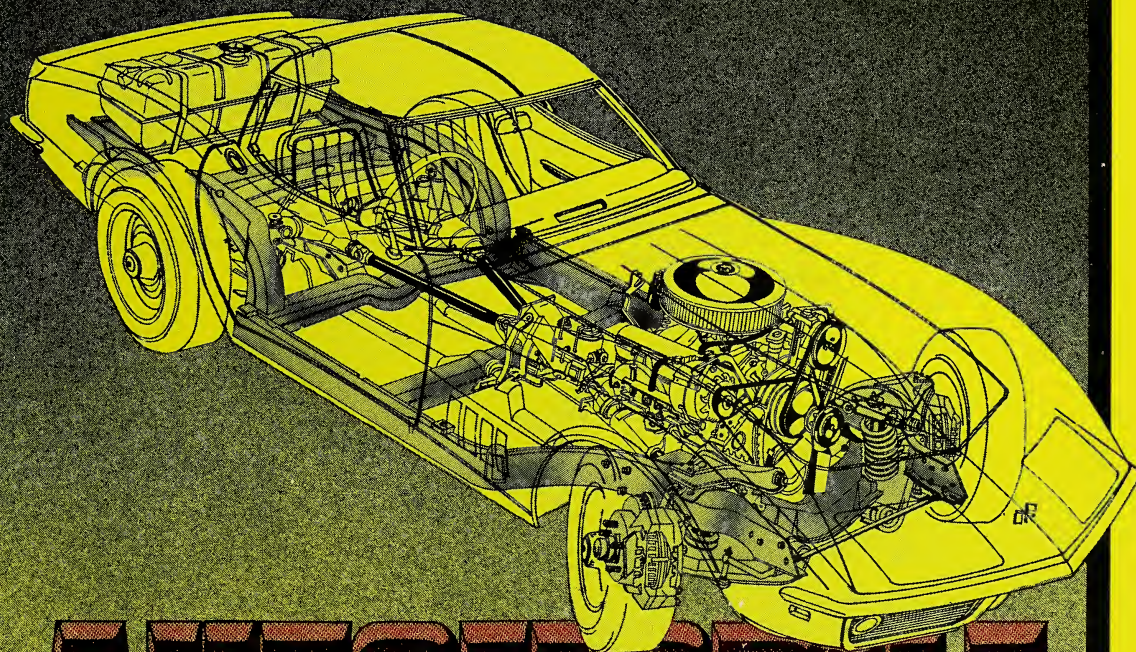


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AUTOMOBILE MAINTENANCE

ALBERTA DISTANCE LEARNING CENTRE ALBERTA EDUCATION BARRHEAD, ALBERTA

CANADIAN

OCT 28 1991

Automobile Maintenance

Lessons 1-4



Alberta
EDUCATION

Automobile Maintenance
Student Module
Lessons 1-4
Alberta Distance Learning Centre
ISBN No. 0-7741-0807-X

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How Your Car Fits Together

This illustration of a car with a V-8 engine shows where the various parts are located and how they fit together. You'll get a better understanding of the function of these parts and how they relate to each other, by referring frequently to this illustration as you read through the lessons.

It's also a good idea to locate on your own car each of the parts named and illustrated here. Although their position and shape may vary somewhat according to the make and model, you'll find that most of them are easy to identify. If you are not sure about any part, ask your service station retailer.

1. Battery

2. Coil

3. Distributor

4. Body

5. Cylinder block

6. Rocker Arm Cover

7. Spark Plug

8. Air Cleaner

9. Carburetor

10. Fuse Box

11. Power Brake Vacuum Booster

12. Brake Pedal

13. Steering Column

14. Steering Wheel

15. Rear Axle

16. Shock Absorber

17. Vapor Line

18. Vapor Separator

19. Fuel Tank

20. Non-vented Filler Cap

21. Hinged Shackle

22. Tail Pipe

23. Leaf Spring

24. Wheel Hubs

25. Brake Drum

26. Differential

27. Universal Joint

28. Muffler

29. Exhaust Pipe

30. Frame

31. Drive Line

32. Fuel Line

33. Master Cylinder (Brakes)

34. Transmission

35. Steering Gear

36. Wheel Brake Cylinder

37. Wheel Spindle

38. Brake Shoe

39. Brake Lining

40. Brake Backing Plate

41. Steering Knuckle

42. Ball Joint

43. Coil Spring

44. Lower Control Arm

45. Upper Control Arm

46. Exhaust Manifold

47. Oil Filter

48. Fuel Pump

49. Crank Shaft Pulley

50. Fan Belt

51. Water Pump

52. Fan

53. Radiator

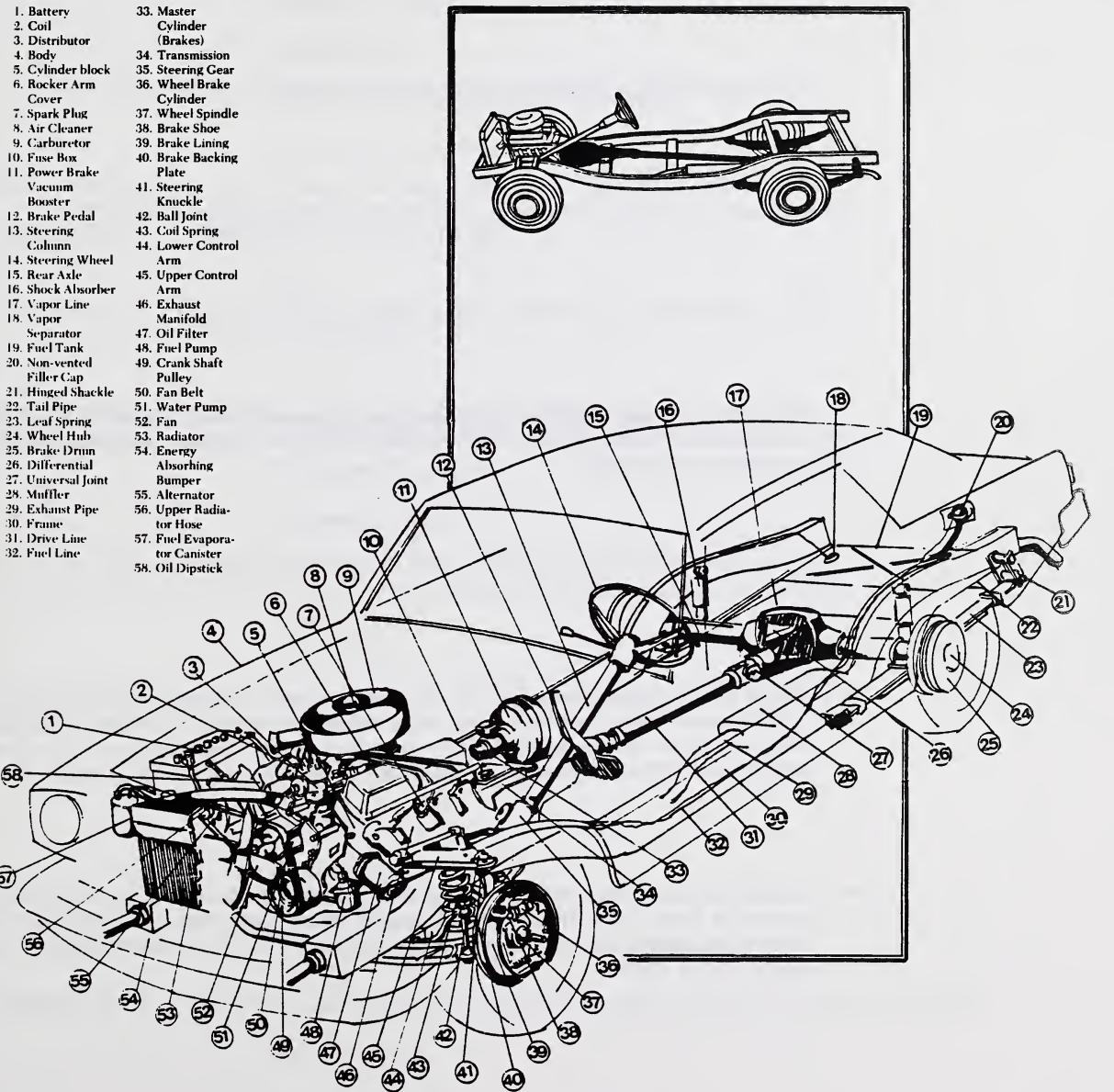
54. Energy Absorbing Bumper

55. Alternator

56. Upper Radiator Hose

57. Fuel Evaporator Canister

58. Oil Dipstick



NOTE: A portion of Lesson 4 involves a practical work assignment. This assignment requires access to a vehicle as well as a qualified mechanic, automotive teacher or a person experienced in automotive maintenance or repair to act as a supervisor of your work.

It is suggested that arrangements be made early for access to a vehicle and a supervisor.

One of the assignments involves an engine oil change. So try to arrange the practical work so that the oil change comes at the correct time or mileage period for the vehicle.

For more details on the practical work assignment, refer to pages 16 to 23 of Lesson 4.

If you have any unusual difficulties in arranging for or doing any of the practical work, please write or phone the Alberta Distance Learning Centre, Vocational Education Department and explain the details of the problem to your teacher.

These calls can be made toll-free from anywhere in Alberta by using one of the following two methods. Always use method (a) below if there is a R.I.T.E. system in your area.

- (a) Students who have a government R.I.T.E. (Regional Information Telephone Enquiry) number in their community (check your local listings under the title Government of Alberta) can dial this number and ask the operator to connect you to the Alberta Distance Learning Centre at 674-5333. **Do not attempt to use method (b) below if you have a local R.I.T.E. number.**

- (b) Students who do not have a R.I.T.E. number in their community can dial "0" and ask the AGT operator for Zenith 22333. When the Zenith operator comes on line, explain that you would like to contact the Alberta Distance Learning Centre. The call will then be connected toll-free to the nearest R.I.T.E. Centre.

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NON-LIABILITY OF THE SCHOOL

While every care has been taken in the preparation of practical work instructions, we cannot be responsible for damage to a vehicle or injury which results from the work you may perform on your vehicle. Carefully follow the procedure and directions given by the person supervising your practical work.

REFERENCES

The following publications will supply additional information on automobile maintenance. They will also include procedures on how to do many of the maintenance procedures listed.

Complete Car Care Manual, Reader's Digest Association (Canada) Ltd., 1981

The Owner's Manual for your specific make and model of car.

Crouse, William H., *Automotive Mechanics*, McGraw Hill Ryerson Ltd., Toronto, 1980

Other repair manuals can be used as well. Make sure they are modern enough and cover your particular vehicle.

GENERAL INSTRUCTIONS

1. When you receive the course, take it apart carefully so that the pages will remain unturned. If you open the book firmly in the middle, the staples will separate and the book will come apart. You can then remove the whole pages without tearing them. Use rings or a looseleaf binder to keep the pages together.
2. Send in for correction, only those pages which require marking. **DO NOT** send in the entire lesson as this just costs you unnecessary money for postage.
3. Try to form good habits of study. After you have read the assigned pages, read through the exercises. See how well you can answer them. If you have difficulty with any of the exercises, you may find it necessary to read the lesson material a second time.
4. Before you start an exercise, be sure that you read the instructions thoroughly so that you understand them.
5. When a lesson is returned to you, study the corrections and comments made by the teacher. Find out what parts of your work have been good, and what parts could be improved. Try to benefit from the corrections. Similar mistakes in successive lessons indicate that the student is not giving sufficient attention to the corrections.
6. Avoid using abbreviations, ditto marks and the symbol "&" for the conjunction "and" in your written answers. All words should be written in full.
7. Before sending a lesson for correction, check to be sure that all exercises are completed.
8. Please use dark ink for all written exercises. Do not write with pencil or red ink. Avoid writing with pencil first and then going over the work with ink.
9. Blank paper tells your instructor nothing and will not be accepted. If for some reason you cannot answer a specific question, then detail for your instructor why you cannot answer and he will try to help you if your reasons are sensible and acceptable.
10. Before mailing your lessons, please see that:
 - (a) All pages are numbered and in order, and no paper clips or staples are used.
 - (b) All exercises are completed. If not, explain why.
 - (c) Your work has been re-read to ensure accuracy in spelling and lesson details.
 - (d) The Lesson Record Form is filled out (name, address with postal code, file number, date of mailing and initials) and placed on top of the lesson exercises.
11. **Do NOT** enclose letters with lessons. Send all letters in a separate envelope.
12. Take your lesson to the Post Office and have it weighed (or refer to the schedule of postal rates which will be enclosed with your corrected lessons). Attach sufficient postage and a green first-class sticker to the front of the envelope, and seal the envelope. Correspondence lessons will travel faster if first-class postage is used. Lessons can be sent in by third-class mail, however, they will take longer to reach the Alberta Distance Learning Centre.

You should try to mail each lesson as soon as it has been completed.

When you register for correspondence courses, you are expected to send lessons for correction regularly but to avoid sending more than two or three lessons in one subject at the same time.

The topic of automobile maintenance is very involved. A mechanic spends four years apprenticing in order to learn the basics of automobile mechanics.

The mechanic learns to disassemble and overhaul engines, transmissions, differentials, do tune-ups and many other things. The first four procedures are ones in which the apprentice receives the most training. It is not feasible for the do-it-yourselfer to handle big jobs, as they require special tools and equipment such as micrometers and hoists.

Do not, however, let this discourage you. There are many things on a car which can be maintained by the car owner without any more than a written-out procedure to follow. Examples of these are: checking engine oil level, tightening or replacing a fan belt and cleaning battery terminals.

The average journeyman mechanic has very little training in the areas of minor adjustment and repairs. Most of it is learned on the job. Hence the car owner can also learn to do minor maintenance and repair of various items. Often, once the car owner does a job (such as changing spark plugs), the second time it is much easier. For subsequent times, it can be done as well as a journeyman mechanic can do it. Practice makes perfect.

This course will cover the very basics of normal maintenance as well as minor repairs. The repair procedures will only be given where no special tools are required or the procedure is not difficult.

It will be an advantage for you to have the Service Manual for your car. This manual lists the specific types of lubricants to use. It also has many diagrams to pinpoint where parts are located. Many other useful things are discussed in a service manual.

SAFETY

Before starting work on a vehicle, it is important to recognize the dangers associated with this type of work. These pointers cover only some of the total safety list, but should give a good general idea of some of the hazards associated with automobile maintenance.

1. Exhaust Fumes

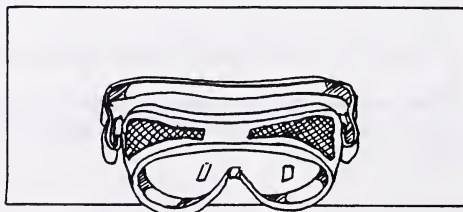
Car exhaust contains carbon monoxide. Carbon monoxide is a colorless, odorless gas which is extremely poisonous. A vehicle should not be operated indoors without the proper exhaust fans or unless the large door of the garage is open permitting good ventilation. Exposure to even small levels of carbon monoxide over a period of time can be fatal.

Rear-seat passengers in cars have been overcome by carbon monoxide from a leaky muffler. Always insure proper ventilation.

2. Compressed Air

Compressed air is extremely dangerous. Using compressed air to blow away dirt on clothes can cause particles to be imbedded in your skin, leading to infection. Particles can also be blown into your eyes causing permanent damage. A blast of air 150 mm to 200 mm from your ear can burst your eardrums.

With proper handling, compressed air is a useful tool for cleaning parts. Always wear eye protection and handle the nozzle of an air compressor hose carefully.



3. Gasoline Hazards

Gasoline is very volatile. Volatility refers to how easily a liquid vaporizes. The fact that gasoline is very volatile makes it dangerous unless properly handled or stored. The fuel from a leaking gas tank will vaporize and can be ignited by a furnace pilot light or cigarette. Gasoline vapors will drift so it is possible for a furnace across the room from the leak to ignite the fumes once they reach a critical level.

Prolonged exposure to gasoline and gasoline fumes is considered hazardous to your health. Avoid exposure to these fumes or to the gasoline itself.

4. Fire Extinguisher

Fire extinguishers, as their name implies, are designed to put out fires. It is a good idea to have a fire extinguisher handy when working on a vehicle, especially when working on gas lines or the carburetor.

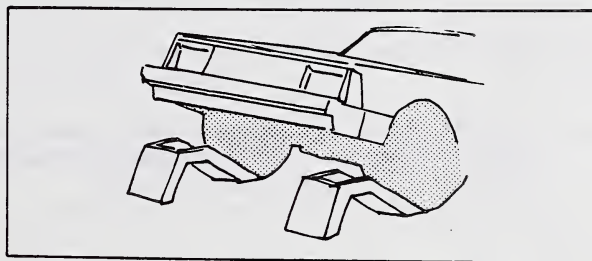
Fire extinguishers are rated according to the type of fire they will extinguish. Use only a fire extinguisher rated for class B and C fires when working on vehicles. These extinguishers are designed to put out electrical and/or chemical fires. These extinguishers will contain carbon dioxide or a dry chemical.

5. Lifting Devices

Do not rely on a jack to support a vehicle while you work under it. Many people have been seriously injured or killed when the jack slipped and the car fell on them.

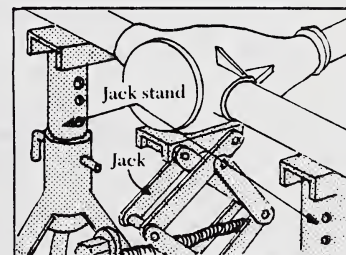
A car must be securely blocked so there is absolutely no chance of it falling on you.

In order to get the vehicle raised and yet securely supported, some car owners buy two ramps. These are available at most automotive supply stores. These work well when doing oil changes.



It is recommended that if you use ramps, you place them on a concrete pad. They may also be used on hard ground, but care must be taken to ensure that the ramps will not sink into the ground and fall over. Once on the ramp, firmly set the parking brake of the vehicle.

Other car owners support their vehicle by placing a jack stand under each side of the car. The car can be raised using the car jack or a trolley jack. Once raised, the jack stands are placed under the axle or frame of the car. The jack stands must be placed under a substantial part of the car as they could bend light panels if placed under them. Jack stands can only be used on concrete floors. They could sink and tip on softer ground.



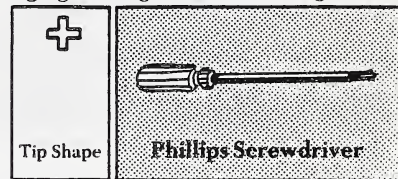
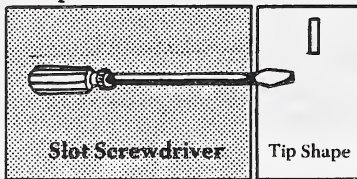
Once the jack stands are in place, lower the car onto them. Then, being very careful, push sideways as well as forward and back on the car to insure it is solidly supported. Be careful, as you may push the vehicle off the jacks if the jacks have not been properly placed.

TOOLS

The tools necessary for the do-it-yourself need not be too complex or varied. A few basic tools will be needed to begin with. You can build your tool selection from these basic tools. Some of the basic tools are listed below.

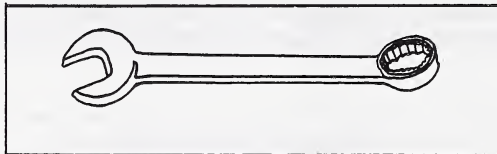
1. Screwdrivers

Two or three sizes of slot or standard screwdrivers will be necessary for general work. Phillips screwdrivers will be necessary for changing headlights and removing trim.



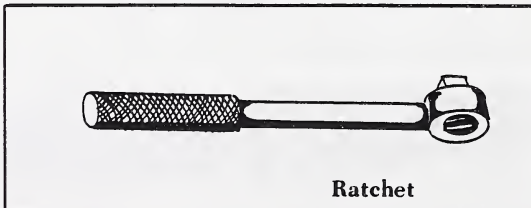
2. Combination Wrenches

These tools are necessary for removing oil level plugs, as well as other parts. Combination wrenches come in sets of varying sizes. Obtain a wrench set which has wrenches large enough to meet your needs.



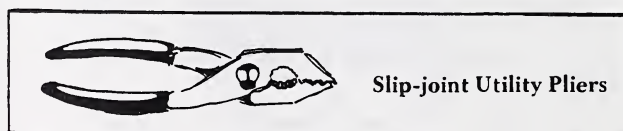
3. Socket Sets

Socket sets contain several sockets, a ratchet, an extension and possible other parts. Sockets are used for general maintenance such as removing nuts from bolts. It is best to obtain a set large enough to meet your needs.



4. Pliers

There are several styles of pliers available. The beginner should choose a utility slip-joint plier as the one to start with. Later, other types and sizes of pliers can be purchased.



APPLICATION FOR LOAN OF A VIDEOTAPE

Name _____ File No. _____

Address _____

_____ Postal Code _____

Please send me on loan the video tape "An Oil Change the Easy Way."

I agree to use the tape carefully and to reimburse the Alberta Distance Learning Centre for any damage sustained to the tape, or for its loss, if it is not returned to the Alberta Distance Learning Centre.

I undertake to view the tape immediately and to return it by insured parcel post in the box in which it was sent to me, within three weeks.

(Date)

(Signature in Writing)

NOTES: This tape is available in VHS format only.

The loan of this video tape is optional. If you do not wish to view the tape, do not return this application form.

The Alberta Distance Learning Centre will not lend a tape to a student with an address outside Alberta.

For office use only

Originated by:	Date:	Authorized by:	Date:
Input by:	Date:	Verified by:	Date:

**A LESSON RECORD FORM MUST BE COMPLETED FOR EVERY LESSON
SUBMITTED FOR CORRECTION, AS ILLUSTRATED BELOW**

A Lesson Record form with the **correct** label attached **must** be enclosed with **every lesson** submitted for correction, as illustrated below.

Correct use of these labels will ensure prompt processing and grading of your lessons.

The enclosed **Lesson Labels** must be checked for spelling and address details.

Please advise the Alberta Distance Learning Centre promptly of any changes in name, address, school, or any other details and we will issue a revised set of labels. Your file number is permanently assigned and **must** be included on all correspondence with the Alberta Distance Learning Centre. If the proper label and Lesson Record Form is not attached to each lesson as indicated it will delay your lessons being processed and credited to you.

Lesson labels are to be attached to the **lesson record forms** in the space provided for student name and address.

Check carefully to ensure that the **subject name**, **module number** and **lesson number** on each label corresponds exactly with the lesson you are submitting.

Labels are to be **peeled off** waxed backing paper and **stuck** on the lesson record form.

Only **one** label is to be placed on each lesson.

LESSON RECORD FORM

FOR STUDENT USE ONLY		FOR A.D.L.C. USE ONLY	
Date Lesson Submitted _____	(If label is missing or incorrect) File Number _____ Lesson Number _____	Assigned Teacher: _____	
Time Spent on Lesson _____		Lesson Grading: _____	
		Additional Grading E/R/P Code: _____	
		Mark: _____	
		Graded by: _____	
		Assignment Code: _____	
		Date Lesson Received: _____	
		Lesson Recorded: _____	

Lesson Number _____

Module Number (if applicable) _____

Course Name and Number _____

Student File Number _____

Bar Code (same information as above) _____

Student's Questions and Comments

Teacher's Comments

LESSON

MODULE

FILE NUMBER

COURSE NAME

Name

Address

Please verify that prepared label is for correct course and lesson

Student name and Address

When revised labels are received, place the correct new labels on your Lesson Record Forms.

St. Serv. 14-81

Correspondence Teacher

DO NOT MARK OR COVER BAR CODING.

CHANGE OF ADDRESS

If the address on your lesson record form differs from the address you supplied on your registration application, please explain. Indicate whether the different address is your home, school, temporary or permanent change of address.

LESSON RECORD FORM

5039 Automobile Maintenance

Revised 88/06

FOR STUDENT USE ONLY

Date Lesson Submitted

(If label is missing
or incorrect)

File Number

Time Spent on Lesson

Lesson Number _____

FOR SCHOOL USE ONLY

Assigned
Teacher: _____

Lesson Grading: _____

Additional Grading
E/R/P Code: _____

Mark: _____

Graded by: _____

Assignment Code: _____

Date Lesson Received:

Lesson Recorded _____

Student's Questions and Comments

Apply Lesson Label Here

Name

Address

Postal Code

Please verify that preprinted label is for
correct course and lesson.

Teacher's Comments:

Correspondence Teacher

ALBERTA DISTANCE LEARNING CENTRE

MAILING INSTRUCTIONS FOR CORRESPONDENCE LESSONS

1. BEFORE MAILING YOUR LESSONS, PLEASE SEE THAT:

- (1) All pages are numbered and in order, and no paper clips or staples are used.
- (2) All exercises are completed. If not, explain why.
- (3) Your work has been re-read to ensure accuracy in spelling and lesson details.
- (4) The Lesson Record Form is filled out and the correct lesson label is attached.
- (5) This mailing sheet is placed on the lesson.

2. POSTAGE REGULATIONS

Do not enclose letters with lessons.

Send all letters in a separate envelope.

3. POSTAGE RATES

First Class

Take your lesson to the Post Office and have it weighed. Attach sufficient postage and a green first-class sticker to the front of the envelope, and seal the envelope. Correspondence lessons will travel faster if first-class postage is used.

Try to mail each lesson as soon as it has been completed.

When you register for correspondence courses, you are expected to send lessons for correction regularly. Avoid sending more than two or three lessons in one subject at the same time.

LUBRICATION FOR YOUR CAR

Lubricants

Engine Oil Change

Chassis Lube

Transmission and Differential Maintenance

Other Oil Level Checks

Introduction

Lubrication is one of the most important elements required for extended car life. Without proper lubrication, parts will quickly wear out. Water in the lubricant will decrease a lubricant's effectiveness. Water can also cause rusting of critical parts. This will result in rapid wear of parts and contamination of the oil. The oil change intervals specified by the manufacturer should always be followed for maximum vehicle life.

LUBRICANTS

Each component of a car (engine, transmission, differential) requires a different type of lubricant. These lubricants cannot be mixed or substituted since damage to components could result.

1. Motor Oil

Engine oils are produced as carefully and within as closely specified tolerances as the engines are. The requirements of the engines are carefully measured under all kinds of operating conditions. Then the oils are developed to satisfactorily handle these requirements. The engines in use today are much more precise than those of earlier times and are also very sensitive to corrosion, etc. The lubricating oils must be produced to protect against many types of problems and also be able to handle more jobs than just lubricating parts.

By-products of incomplete combustion are the primary source of substances which cause corrosion and engine deposits. When the fuel is burned in an engine, approximately 1 L of H_2O is formed for each litre of fuel burned. Although most of this water leaves the engine in gaseous form through the exhaust system, some of it does condense on the cylinder walls (more so in colder weather). This moisture then goes past the piston rings and into the crankcase. Other corrosive materials also find their way past the rings and into the crankcase such as sulfur, gum deposits and carbon from the burned fuels. The life of the engine depends on the ability of the oil to neutralize these harmful substances. This is done through the addition of oil-soluble chemical compounds into the oil at the treating plant.

Under ideal conditions, gasoline burns in air to form carbon dioxide and water. For a variety of reasons, an internal combustion engine is not ideal and therefore, all of the gasoline does not burn. That which does not burn becomes soot and/or carbon. Some of this also gets into the oil and is the major ingredient in the formation of sludge and varnish. This and many other problems must be overcome by chemical additives. **One thing to be remembered is that the oil itself never wears out, but, the additives in the oil do wear out.** Depending on conditions, this sometimes happens quite fast. So remember always change your oil and filter every 5000 km or every three months, whichever comes first. Also, if you are hauling heavy loads, driving very fast, starting and stopping a lot, driving in extremes of temperature or on dusty roads, the oil change should be made more often. At any rate, never exceed the manufacturer's recommendations because he has thoroughly tested his product.

To summarize, a motor oil must do all of the following:

- (a) permit starting and circulate promptly;
- (b) lubricate and prevent wear;
- (c) reduce friction and act as a cushion;
- (d) protect from rust and corrosion;
- (e) keep the engine parts clean;
- (f) cool the engine parts;
- (g) act as a sealant against combustion pressures;
- (h) be non-foaming.

Most of these categories can be adequately taken care of by choosing a good grade of motor oil. A good grade of oil for gasoline engines will have SF printed on the can in capital letters. For vehicles with diesel engines use an oil with CC or CD on the can. Check your owner's manual.

The vehicle operator does have a choice of the thickness (viscosity) of the oil he purchases. The relative ease in starting an engine depends on many things, one of these is the oil that is lubricated with. If the oil is too heavy (thick), it will impose too great a drag on the moving parts and the engine will not turn over fast enough to start. Temperature has a direct effect on oil also, and the colder it is, the thicker the oil will become. So especially in colder climates, the oil must be such that it will remain thin enough not to impede the cranking of the motor. It must also be fluid enough to flow nearly instantly through all the small lubricating lines and holes. But it must at the same time be of such consistency that as the engine reaches operating temperatures, it does not thin down too much from the high temperatures.

The characteristic of an oil which determines the above property is its viscosity. Viscosity is a measure of the resistance of oil to motion or flow. This resistance keeps it from being squeezed out of bearing and other surfaces when they are moving under pressure (load). This resistance is due to the adhesive and cohesive forces of the oil molecules.

The Society of Automotive Engineers (SAE) has established a classification system for crankcase lubricating oils based on viscosity numbers. All motor oils are classed this way and are given a viscosity number. The numbers in use today are **SAE5W, 10W, 20W, 20, 30, 40 and 50**. The smaller numbers indicate the oil is thinner (flows easily), while the higher numbers indicate the oil is thicker (more resistant to flow). The W following the three lowest numbers denotes that these oils are suitable for winter operation in below freezing temperatures. The oils with a W after their viscosity numbers have been tested and their viscosity numbers determined by how they flow at -18°C while the other oils are tested at 99°C .

Because the effect of temperature changes upon the viscosity varies widely with different types of oil, a standard measurement of the amount of such change was established. This is known as the **Viscosity Index (VI)**. A high viscosity index oil is one that shows a relatively small change in viscosity over a wide range of temperatures.

With today's advanced technology, we now have oils that can perform over very wide ranges of temperatures and we call them multi-grade oils or multi-viscosity oils. These oils meet the requirements of two or more different viscosities and will be labelled with lowest viscosity number first to the highest range of viscosity number that they cover for. The multi-grades will be labelled **SAE5W-20, SAE5W-30, SAE10W-20W-30, SAE10W-30, SAE10W-40 and SAE20W-40**.

TYPICAL TEMPERATURE RANGE FOR VARIOUS OILS

SAE GRADE	TEMPERATURE RANGE	RECOMMENDATIONS
5W-20	up to -15°C	use under -15°C only (slow speed)
5W-30*	up to 15°C	use under 15°C only (slow speed)
10W-20W-30	-25°C to 35°C	all season use
10W-30		
10W-40	-25°C to 40°C	
20W-40	-5°C to 40°C	for use in summer
20W-50	-5°C to 45°C	
10W	-25°C to 15°C	Use only for temperature ranges shown
20W-20	-10°C to 30°C	
30	0°C to 35°C	
40	10°C to 45°C	

*Some manufacturers warn against using this grade at summer temperatures, others strongly recommend it for all season use.

2. Gear Oil

Gear oil is required to lubricate the differential of standard rear-wheel drive vehicles.

The viscosity of gear oils vary from SAE75 to SAE140. Most car manufacturers recommend SAE90. The reason gear oils are heavier than engine oils, is the gear trains tend to take large forces which would tend to squeeze lighter lubricants from between the gear teeth.

Modern gear lubricants are referred to as hypoid gear oil. Hypoid gear oil is called an extreme pressure lubricant. It is not easily squeezed from between the gears. It is used in all modern, standard rear-drive car axles. It is also used in some standard transmissions. Hypoid gear oil is the preferred type to buy as it can be used whenever gear oil is required. Hypoid gear oil will have the American Petroleum Institute rating of GL5 written on the can.

Warning: Some differentials have positraction, or non-spin, differentials. These require a special lubricant. See your operator's manual for the particular type to be used.

NOTE: Always check the owner's manual for your vehicle to determine the correct type of oil to use.

3. Chassis Lubricants

Most chassis lubricants are general purpose. This means they can be used for a variety of lubricating jobs such as for chassis, wheel bearings, universal joints, etc. You should look for a good grade, extreme pressure or EP grease as a chassis lubricant.

4. Automatic Transmission Oils

Automatic transmission fluids come in two types. They must not be interchanged.

(a) Dexron Automatic Transmission Oil

This is the type of oil which must be added to the automatic transmissions of General Motors products, Chrysler products and most imports. (Check your owner's manual to make sure.) Do not use this oil in Ford products unless specified.

(b) Ford Type F Automatic Transmission Oil

This is designed specifically for some Ford automatic transmissions. Do not use it in other manufacturers' vehicles. (Check the owner's manual for your car to find the correct type of automatic transmission fluid to use.)

ENGINE OIL CHANGE

Regular changes of engine oil is one of the most important services performed on an automobile engine. Recommended oil-change intervals vary from manufacturer to manufacturer. This oil-change interval is stated in the owner's manual. In fact, there will be two oil-change intervals specified. The longer interval is for ideal driving conditions. This type of driving occurs on long trips at relatively steady speeds. The shorter interval is usually described as severe service and involves short trips, stop-and-go driving, extremely cold weather travelling or trailer towing. This is the type of driving that most people in Alberta do.

A good guideline is to change oil every 5000 km or 3 months. However, at no time should you exceed the manufacturer's recommendation.

The life of a car engine is proportional to the length of time between oil changes. In other words, if you were to stretch oil-change intervals, this would shorten the engine life. On the other hand, very frequent oil changes would prove costly for oil and filters and in addition would cause the inconvenience of more trips to the service station or more afternoon oil changes at home. It is best to follow the recommendations in the vehicle operator's manual.

One of the problems with doing your own oil change, is how to dispose of the used oil. It should never be thrown on the street, roadside, etc., as it causes pollution. The best way is to locate a garage or service station which will allow you to dispose of your oil into their waste drums. Another idea is to buy your new oil from an outlet which has disposal arrangements.

At the time you do an oil change, the oil filter should also be changed. The purpose of the oil filter is to clean dirt, sludge and other impurities from the oil. Filters can clog up and become ineffective if not changed regularly.

1. Special Tools and Equipment Required

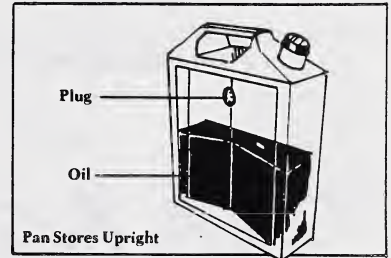
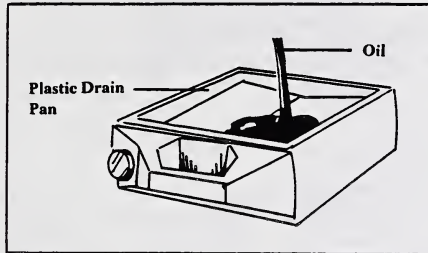
The types of tools and equipment needed for an oil change can vary considerably. Some oil-change jobs have been done with little more than an adjustable wrench and a screwdriver. The oil drain plug can be removed with the adjustable wrench and the filter can be removed by driving the screwdriver through the sides of the filter and turning.

This procedure is not recommended as it produces quite a mess, causes pollution and because proper tools are easily obtained at reasonable prices.

In the following section of the lesson, the special tools necessary for an oil change will be discussed.

(a) Oil Drain Pan

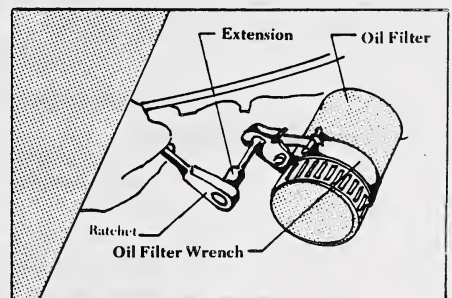
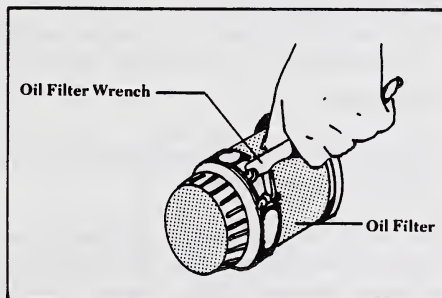
A container suitable for draining the oil into is required. This could be a plastic basin or a size suitable for holding 5 or 6 litres of oil. Its size would be approximately 30 cm wide by 40 cm long by 10 cm high. It could also be a special plastic drain pan that can store your waste oil. These are available at most automobile parts stores.



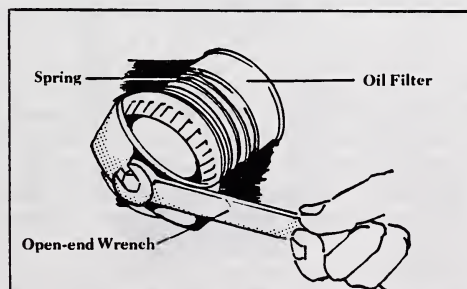
(b) Oil Filter Wrench

The oil filter tends to seize on quite tight after use and hence is difficult to remove. For this reason, an oil filter wrench is necessary. These come in a variety of styles and are available at all automotive supply stores. Some of the styles of oil filter wrenches are shown below. Regardless of the type chosen, make sure it is a heavy duty model.

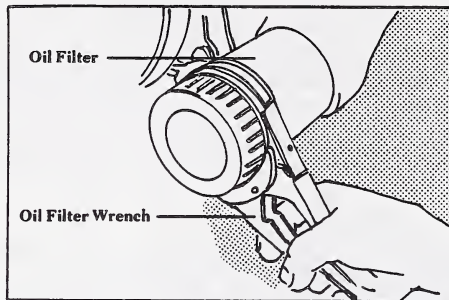
(i) Strap-type oil filter wrench



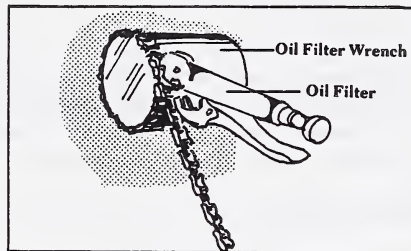
(ii) Coil-spring oil filter wrench



(iii) Pliers-type oil filter wrench



(iv) Chain-type oil filter wrench



(c) Other Tools and Equipment

It is handy to have either or both a pour spout for your oil cans or a funnel to direct the oil into the oil filter spout on the engine.

If your car is very low and you cannot crawl under it to remove the oil drain plug or filter, you will require a method of raising the front of your car. A jack by itself must never be used to support the front of the vehicle. If the jack slips, the car will fall and crush you.

A pair of ramps or two jack stands will be necessary to support the vehicle. These are explained in detail in the introduction to this course.

(d) Supplies

In order to do an oil change, you will of course need the oil on hand. It is best to purchase oil in one or four-litre containers in a quantity sufficient for one oil change. A check of your owner's manual will indicate how much oil is required for your car. Usually, an extra litre is required when the filter is changed. Choose the correct oil viscosity for the temperature range and type of driving conditions you expect to encounter.

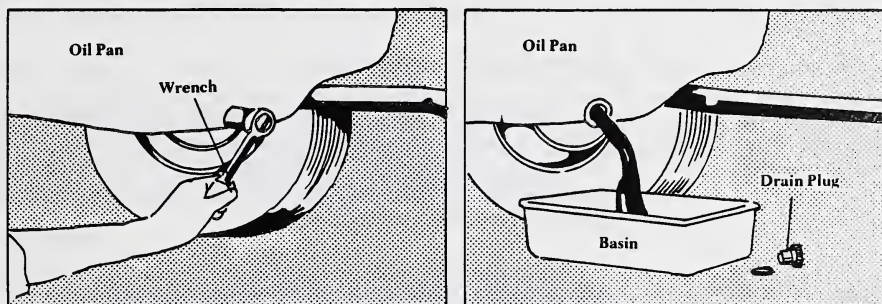
An oil filter is also required. These are available at automotive supply stores. These stores have charts which will indicate the correct size for your car.

2. Oil Change Procedure

The car must be parked in a suitable place. If necessary, ramps or jack stands should be used. The engine should be warm at the time of the oil change so all the sludge is suspended in the oil.

(a) Draining the Oil

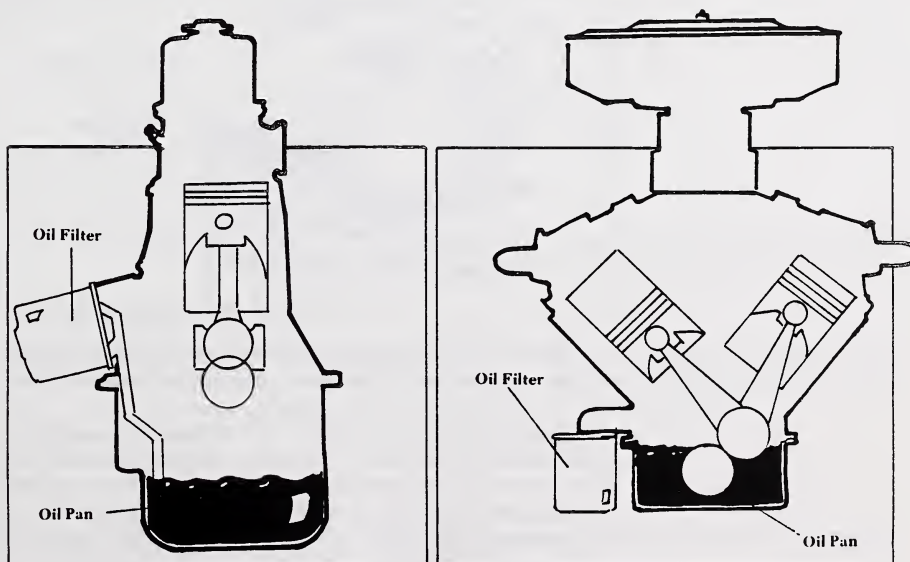
Locate the oil drain plug. It is usually on the bottom rear portion of the oil pan. Remove the drain plug using a socket wrench or a combination wrench.



Insure that the oil drain pan is properly positioned to catch all of the oil. Allow the oil to drain. This will require 5 minutes or so.

(b) Removing the Oil Filter

Locate the oil filter. On inline four or six-cylinder engines, the filter is on the side of the engine just above the oil pan. On V-six or V-eight engines, the oil filter will be on the underside of the engine above the oil pan.



Use one of the oil filter wrenches discussed earlier and remove the oil filter. The drain pan should be located so as to catch the oil which will run out as the filter is loosened.

(c) Installing the New Filter

First lubricate the gasket on the new filter with a few drops of engine oil. This makes sure the gasket does not grab and slide out of place when the filter is tightened. It also aids in removing the filter at the next oil change. Next ensure that the area around the filter base on the engine is clean. Use a clean, soft cloth or a clean paper towel to remove any particles.

Thread the filter onto the mounting stud until the filter gasket contacts the engine mounting plate. Then, by hand, tighten the filter an additional one half to one turn.

(d) Reinstall the Oil Drain Plug

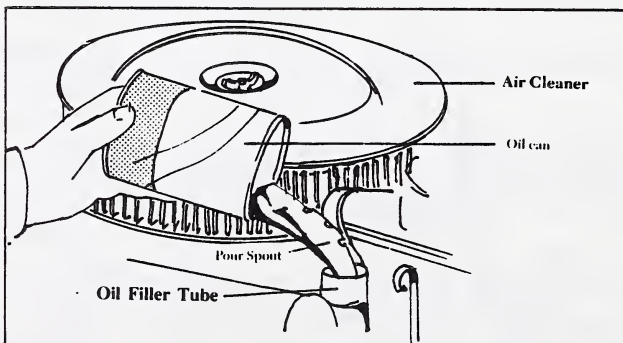
Check the oil drain plug to insure the plastic gasket is not cracked. If it is cracked, replace it with a new one. If the drain plug is in good condition, reinstall and tighten it. If the plug is not tightened sufficiently, there is a danger it will leak or possibly vibrate loose and fall out. This would cause loss of engine oil and the possibility of engine damage caused by the lack of lubrication.

Overtightening of the drain plug on the other hand may lead to stripping of the threads on the plug. If by chance, you do strip the threads, oversized self-tapping drain plugs are available at automobile parts stores.

These will cut new threads as they are installed in place of the original drain plug. Make sure the new plug has a gasket on it.

(e) Add the Oil

Using a pour spout or a funnel, add the oil to the oil filler spout. The oil filler spout will be located in the top of the valve cover.



Once the required amount of oil has been poured into the engine, replace the oil filler cap. Check your owner's manual for the required amount of oil. Do not add more oil than necessary. Excess oil will cause foaming to occur and foam is a poor lubricant.

Start the engine. Look for leaks around the filter. If a leak is noticed, shut the engine off and retighten the filter. Restart the engine and again check for leaks.

Check the engine oil pressure. The oil pressure should be in the normal operating range. It may however, take up to a minute to develop normal oil pressure, as the filter first has to fill with oil. If there was little or no oil pressure when you checked for leaks, then recheck for leaks once the oil pressure is normal. Do not race the engine until you have normal oil pressure as the engine will not be properly lubricated and may be damaged.

Check the oil level on the dipstick. The oil level should be between the **add** and **full** marks, preferably closer to the full mark. Do not run the vehicle with the oil level above the full mark.

CHASSIS LUBE

A chassis lube job (or grease job as it is sometimes called) can be more complex than an oil change. You have to locate all the grease nipples on your vehicle. One missed greased nipple can lead to rapid wearing of parts. There are two ways to insure that no grease nipples are missed. One way is to check the service manual for your car for the lubrication points. The other way is to talk to a mechanic familiar with your model of car. Once all grease nipples are located, they are easy to relocate for the next grease job.

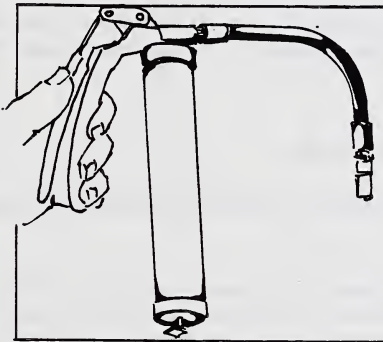
At the time you look through the service manual or talk to the mechanic, find out how often your vehicle should be given a chassis lube job.

If by chance your vehicle has plugs installed instead of grease nipples, you have two options. One option is to purchase grease nipples from an automobile parts store. They would tell you how many you need. The plugs are then removed and grease nipples threaded into the openings. The other option is to take the vehicle to a service station for the first lube job. Then have the service station install the grease nipples.

1. Tools and Equipment Required

Some specialized equipment is required to do a lube job. This is in addition to the ramps or jack stands (explained in the introduction of this course) needed to raise the vehicle so you can work under it.

(a) Grease Gun



A grease gun is required for chassis lube jobs on all vehicles. Ensure you have a supply of good quality chassis lube grease cartridges for use in your grease gun.

(b) Other Useful Equipment

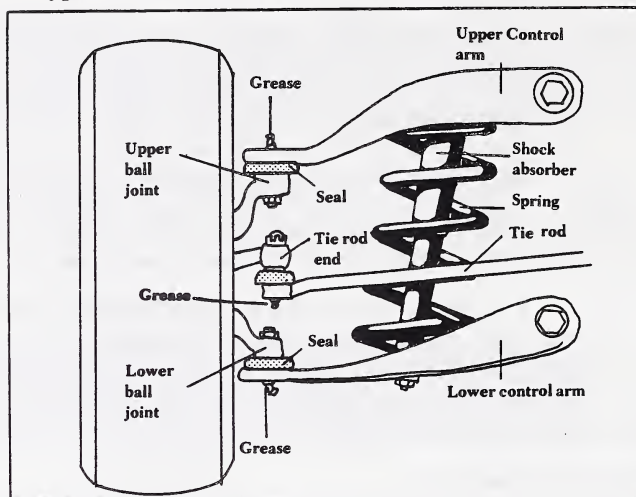
- (i) Trouble light — This is a shielded light which is very useful for supplying light when working under vehicles or in other darker areas.
- (ii) Rags to clean grease nipples.
- (iii) Creeper — A creeper is very handy for two reasons. One is that your clothes stay cleaner as you lay on the creeper and not the floor. Secondly, the creeper allows you to roll under the vehicle very easily.

2. Chassis Lube Procedure

The car must first be raised at the front end so you can get close to the grease nipples. Oil change time is also an ideal time to do a chassis lube.

Once you are under the car, wipe the grease nipples clean of any dirt. This will help prevent contaminants from entering the ball joint.

Typical North American Full-Size Car Grease Points



When lubricating ball joints, squeeze grease in until you see or feel the rubber beginning to swell, or until grease begins to flow from the bleed area at the base of the seal. If you overfill the joint and the seal swells, it could burst requiring replacement of the seal. Carefully inspect rubber seals (for cuts or breaks) at this time. Damaged seals should be replaced as they will allow dust to enter into the joint.

Remember to carefully inspect universal joints as these may or may not have grease nipples. Most new cars do not have grease nipples on the universal joints. They are sealed units lubricated for life.

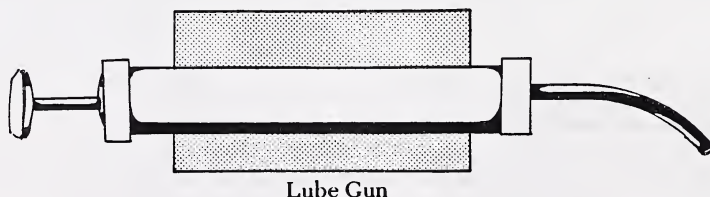
TRANSMISSION AND DIFFERENTIAL MAINTENANCE

Normal maintenance for transmissions and differential involves checks of the fluid level to insure the oil is not low.

Extended maintenance for automatic transmissions involves a filter and oil change. This will not be discussed in this course as it is beyond the level of basic automobile care.

1. Tools Required

- (a) Flexible neck funnel.
- (b) Wrenches to remove plugs.
- (c) Lube gun (for differential and manual transmissions).



Differentials and manual transmissions may require special tools to remove the oil level plug. Check the plugs and insure you have the correct type of wrench to remove it.

2. Transmission Oil Level Check

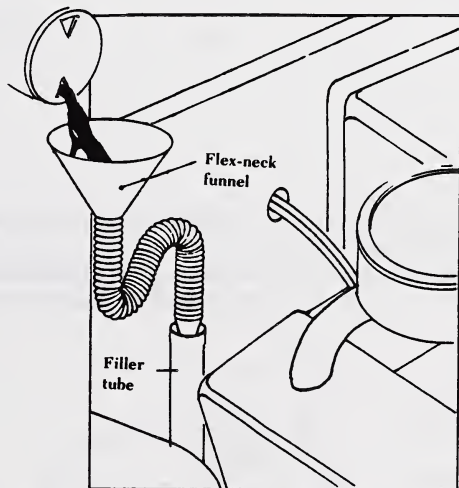
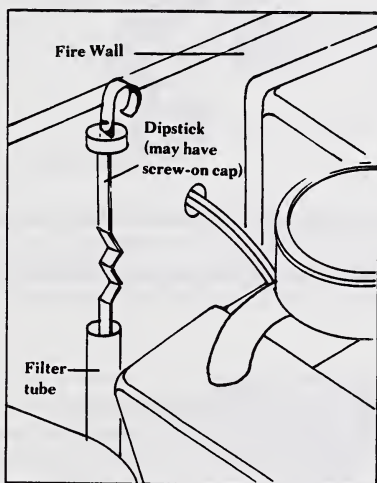
(a) Automatic Transmissions

Automatic transmission oil levels should be checked every few months. Most manufacturers recommend checking the level every time you change the oil.

Automatic transmission oil levels are checked with the engine and transmission at operating temperature. Oil expands as it is heated, and the temperature of the oil will affect the oil level. The engine is left running while the oil level check is made.

On Datsun, Honda, Ford and General Motors cars, move the transmission shifter through all positions (1 - 2 - 3 - N - R - P) and then place it in park. With Toyota, Volkswagen, Chrysler and American Motors cars, move the transmission shift lever through all positions and then move to neutral.

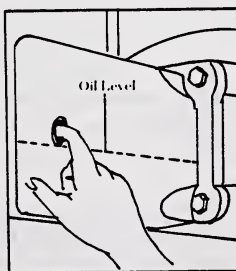
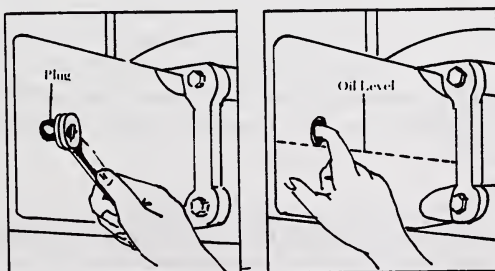
The level of fluid is checked on the dip stick. This is found in the transmission filler tube located in the rear of the engine compartment.



Make sure you do not overfill the transmission. This causes air to be drawn into the oil. The resulting foam can cause clutch burning and other major problems.

(b) Manual Transmissions

The first step in checking the oil level in a manual transmission involves finding the oil level plug. It is found on the side of the transmission case near the middle.

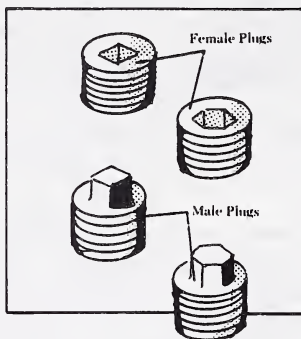


The oil level should be up to the bottom of the plug. To be on the safe side, check your operator's manual to find the correct type of fluid to use to fill the transmission.

Oil is added with a lube gun which has a flexible spout. The spout can be inserted into the oil level hole and oil added.

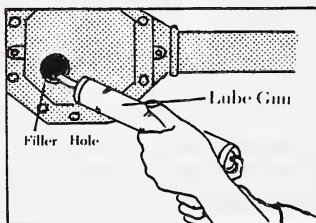
3. Differential Oil Level Check

As with manual transmissions, the differentials could have many styles of plugs.



Some vehicles use rubber inserts pressed into the filler hole instead of metal plugs.

The oil level should be up to the bottom of the plug. Check your operator's manual as to the type of lubricant to use.



Adding Oil

OTHER OIL LEVEL CHECKS

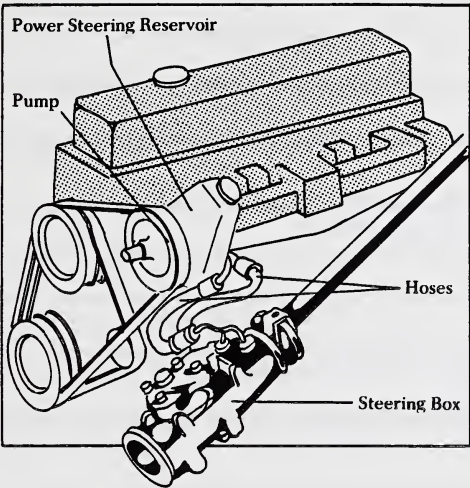
1. Steering System

The location of the reservoir and the oil level checking method for the steering system will vary depending on whether you have power steering or manual steering in your vehicle.

(a) Power Steering

The power steering system in a car has a dip stick in the oil reservoir. This is easy to locate as the pump is built into this reservoir and is driven by a V-belt. the dip stick will be attached to the cap on the top of the oil reservoir. As with an automatic transmission, check the oil level after the vehicle has been warmed up.

Check your operator's manual for the correct type of oil to use. The chart below can be used, but it may not be completely accurate for all vehicle models.



Recommended Lubricants	
Car Model	Power Steering Lubricant
AMC Chrysler Ford (1973-77) GM	Power steering fluid
Ford (1978 and later)	Automatic transmission fluid, Type F
Chrysler imports Datsun Honda Toyota	DEXron automatic transmission fluid

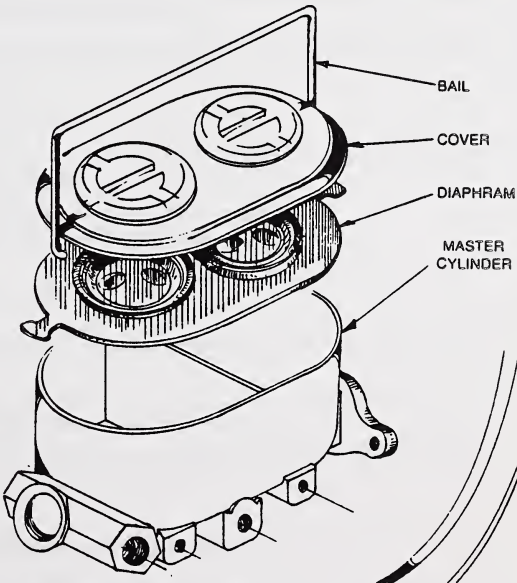
(b) Manual Steering

Some manual steering gearboxes are lubricated for life. Others require lubricant level checks and the addition of oil if necessary. As there are a variety of oil level plugs, locations, service schedules and oil types to use, depending on the make of vehicle, it is best to consult the service manual for your vehicle as to the correct one to use.

2. Brake System

Brake systems in good condition rarely, if ever, require the addition of brake fluid. Periodically, the brake fluid could be checked. A low level of fluid will be an indication of leakage. The exception is if the front reservoir is low on cars with disc-brake systems. As the brake pads wear, the level goes down. When the brake pads are replaced, the fluid level will rise to normal level. Do not add fluid to this reservoir if the pads are worn unless the level is very low.

Before removing the filler cap on the brake reservoir, clean all dirt away from it. Make sure the rubber diaphragm is in good condition.



It moves up and down with the fluid and keeps moisture in the air from reaching the fluid. Moisture can enter the fluid and cause severe damage to the system.

Use only brake fluid marked DOT3 or DOT4. These have a high enough boiling point to withstand the high temperatures generated by disc brakes.

COMPLETE THE FOLLOWING EXERCISES AND SEND THEM IN FOR CORRECTION.**EXERCISE 1**

1. If oil never wears out, why do you have to change engine oil regularly?

2. Operator's manuals for vehicles suggest you use a good grade of motor oil. How do you tell if a motor oil is of a good grade?

3. A can of oil has 10W-30 written on it. Explain what each of the following parts mean.

10 -

W -

30 -

4. Why is hypoid gear oil required for standard rear differentials?

5. Which type of automatic transmission oil is used in each of the following cars.

(a) 1979 Chrysler Cordoba

(b) 1977 GMC ½ ton truck

(c) 1980 Ford ½ ton truck

6. What is a good guideline to use for determining when to change oil?

7. When determining oil-change intervals, what driving conditions are considered severe?

8. What is the best way to dispose of used engine oil?
- _____
- _____
- _____
9. How often should the oil filter be changed?
- _____
10. How many litres of oil does your vehicle (or one you have access to) hold?
- _____ litres with an oil filter change.
- _____ litres without an oil filter change.
11. Why is a special drain storage pan better for oil changes than an ordinary pan?
- _____
- _____
- _____
12. (a) Where is the oil filter mounted on your vehicle?
- _____
- _____
- (b) What make and model of vehicle is it?
- _____
13. List the supplies and equipment required to do your own oil change.
- (a) _____ (b) _____
- (c) _____ (d) _____
- (e) _____ (f) _____
14. Removing the oil drain plug is the first step in the oil change procedure. What is the second step?
- _____
15. Why is oil placed on the gasket of a spin-on oil filter before placing it on a vehicle?
- _____
- _____

16. If excess oil is added to the engine, what will be the likely result?

17. Why should you never race the engine before engine oil pressure is up to normal?

EXERCISE 2

1. What should be done if you go to grease your car and find that it has no grease nipples?

2. What type of grease is best for lube jobs?

3. Automatic transmission fluid cannot be checked at anytime. Explain under what conditions it is possible to check the level and have an accurate reading of the oil level.

4. Why should you not add just any type of oil to the rear differential of a car? Give two reasons.

(a)

(b)

5. Brake systems do not normally require the addition of brake fluid. If the fluid level is low, what should you suspect?

LESSON RECORD FORM

5039 Automobile Maintenance

Revised 88/06

FOR STUDENT USE ONLY

Date Lesson Submitted

(If label is missing
or incorrect)

File Number

Time Spent on Lesson

Lesson Number

FOR SCHOOL USE ONLY

Assigned
Teacher: _____

Lesson Grading: _____

Additional Grading
E/R/P Code: _____

Mark: _____

Graded by: _____

Assignment Code: _____

Date Lesson Received:

Lesson Recorded _____

Student's Questions and Comments

Apply Lesson Label Here

Name

Address

Postal Code

Please verify that preprinted label is for
correct course and lesson.

Teacher's Comments:

Correspondence Teacher

ALBERTA DISTANCE LEARNING CENTRE

MAILING INSTRUCTIONS FOR CORRESPONDENCE LESSONS

1. BEFORE MAILING YOUR LESSONS, PLEASE SEE THAT:

- (1) All pages are numbered and in order, and no paper clips or staples are used.
- (2) All exercises are completed. If not, explain why.
- (3) Your work has been re-read to ensure accuracy in spelling and lesson details.
- (4) The Lesson Record Form is filled out and the correct lesson label is attached.
- (5) This mailing sheet is placed on the lesson.

2. POSTAGE REGULATIONS

Do not enclose letters with lessons.

Send all letters in a separate envelope.

3. POSTAGE RATES

First Class

Take your lesson to the Post Office and have it weighed. Attach sufficient postage and a green first-class sticker to the front of the envelope, and seal the envelope. Correspondence lessons will travel faster if first-class postage is used.

Try to mail each lesson as soon as it has been completed.

When you register for correspondence courses, you are expected to send lessons for correction regularly. Avoid sending more than two or three lessons in one subject at the same time.

TIRES AND COOLING SYSTEM

Tires

Cooling System

Introduction

On most cars, the tires cause very few problems. Today's tires are made better than the tires of years ago. Tire tread life is in the range of 30 000 to 60 000 km or more. Tires do, of course, have to be checked regularly for both abnormal wear patterns and amount of air pressure. This lesson will deal with tire identification, tread checks, and tire pressure checks.

The cooling system in a car is critically important. Any serious malfunction in the cooling system can ruin a vehicle's engine. It is fortunate that very few problems develop. Regular maintenance is required, however, to help prevent any serious problems.

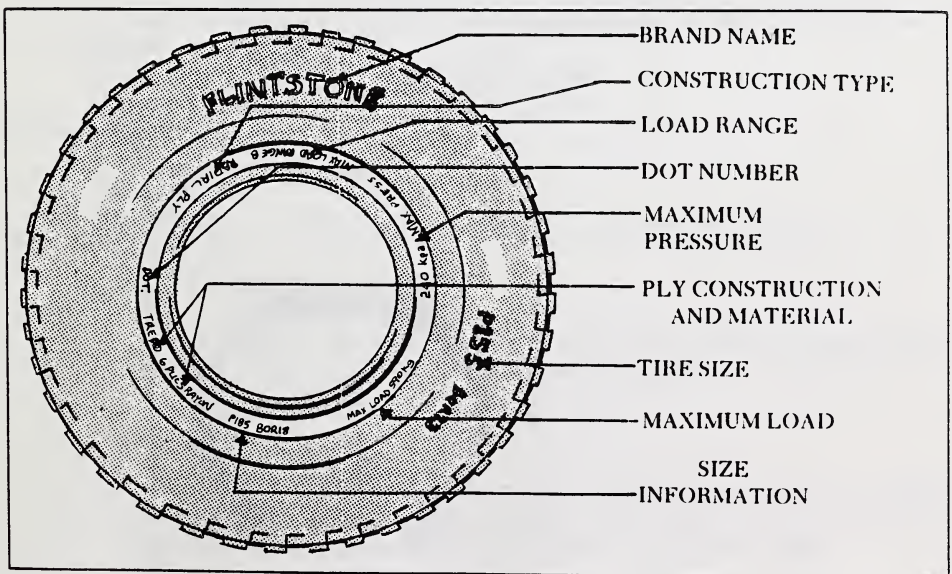
TIRES

1. Construction

Tires are the contact point between your car and the road. It is imperative that they be maintained according to manufacturers' specifications.

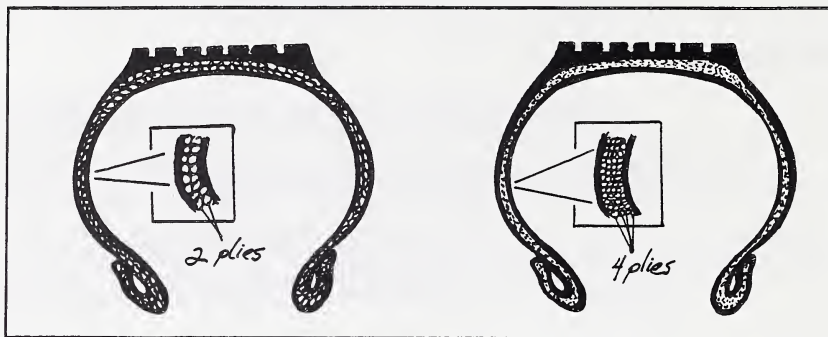
Tires serve two main functions. They provide a cushioning action that softens the jolts caused by rough roads. They also provide proper traction enabling the car to drive itself forward, provide a means of steering and allow reasonably fast stopping.

All tires are marked showing maximum load carrying capacity and pressure, size, load range, ply construction, material identification, DOT (Department of Transportation) number and construction type. All this information is very important when choosing the proper tire for your vehicle and driving conditions.



Ply rating is a general indicator of load carrying ability. It does not necessarily indicate the actual number of plies used. (See diagram below.)

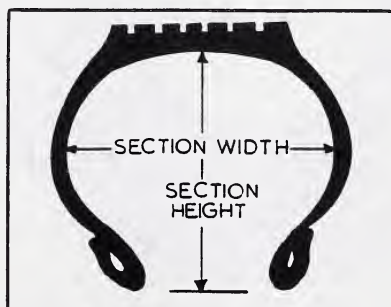
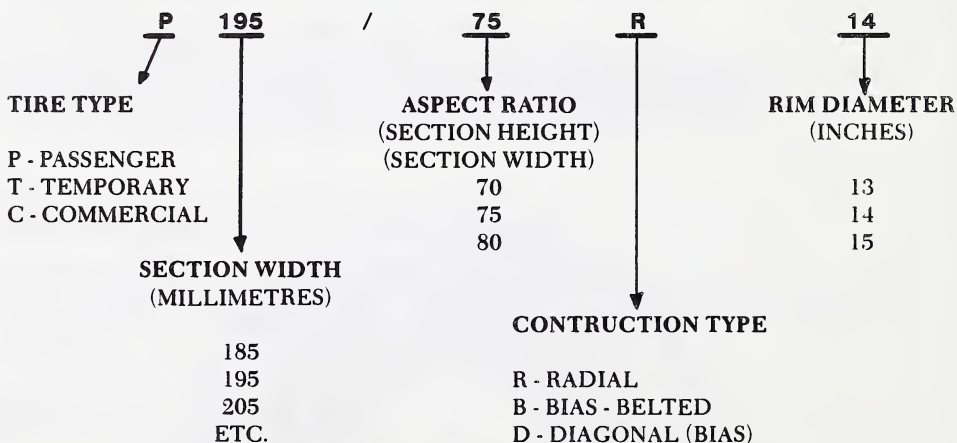
Load range indicates a tire's load capacity as well as the number of plies and the maximum air pressure that may be used.



A two-ply/four-ply rating tire has the same load capacity as a four-ply/four-ply rating tire. Note how much thicker two-ply cords are than those in four-ply.

Most modern automobile tires are tubeless. This means no rubber innertube is used. The tire and rim must form a leakproof unit, therefore, the tire and rim must be in good condition.

Tire manufacturers are now rating tires in metric sizes. Tire size information is imprinted on the sidewall of every tire.



TIRE TYPE - letter indicates the specific use for the tire

SECTION WIDTH - indicates the measurement in millimetres from sidewall to sidewall

ASPECT RATIO - indicates the relationship between section height and section width. For example, a "75" here would mean that the average section height is 75 percent of the width. The lower the number is, the lower the "profile" (extremely wide in relation to height) of that particular tire.

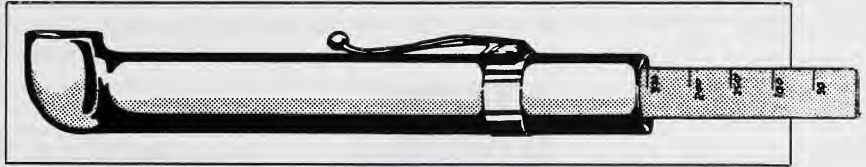
CONSTRUCTION TYPE - this letter specifies how the tire is built

RIM DIAMETER - this number indicates the diameter of the rim (wheel). Note - this is presently indicated in inches.

2. Special Tools and Equipment

(a) Tire Pressure Gauge

A tire pressure gauge is necessary to check tire pressures. You cannot go by the looks of the tire. This is especially true of radial tires which always look low but in fact have adequate air pressure.



(b) Source of Compressed Air

In order to inflate tires, a source of compressed air is required. Compressed air is available from many sources.

(i) Service stations

(ii) 12-volt portable compressors

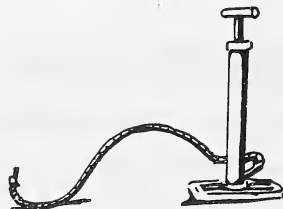
These are available in most hardware or automotive parts stores.

(iii) 120-volt home air compressors

These are quite expensive, but can be used for many other jobs such as paint spraying, cleaning parts, etc. in addition to inflating tires.

(iv) Hand tire pump

These are available in most hardware or automotive parts stores. It requires a lot of energy to pump up a flat car tire by hand. However, they do work and they are the least expensive to buy. (See diagram on the next page.)



3. Checking Air Pressure

The largest single enemy of a tire is underinflation. This is followed by overinflation and then overloading.

Tire pressure should be checked monthly. Air can leak from tires over a period of time. Also the pressure can change in a tire as the outside air temperature changes.

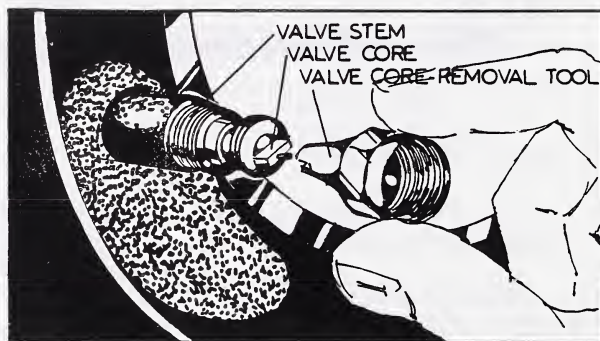
Sources of leaks can be from punctures, leaks around the bead (or rim), or leaks in the valve core.

(a) Valve Core Leaks

After testing tire pressure, the valve core should always be checked for leaks. This can be done using soapy water placed on the end of the valve stem. Look for an air bubble forming on the end of the valve stem. If a bubble does form, there is a leak in the valve. Leaks in a valve can be corrected in one of two ways.

(i) Tighten the valve core

The valve core may be loose. This would allow air to leak by the threads in the valve. The valve can only be tightened using special tools. One of the most common valve removal and tightening tools is a special valve cap.



After tightening is complete, retest for leaks. If the core still leaks, see section (ii) below. A good valve cap will seal the valve until a replacement core can be found.

(ii) Replacing the valve core

If the leak cannot be stopped in the valve core, the valve core will have to be replaced with a new one. Do this in a location where compressed air is available to reinflate the tire.

A replacement valve core should be purchased first. Next, thread out the old valve core. Be careful as the valve core can be blown out by the air pressure in the tire as it is loosened. Once the old core is removed, immediately install and tighten the new core. Reinflate the tire and then recheck for leaks.

(b) Leaks from the Bead or Rim Area

taken to a tire repair shop. Leaks in this area usually mean the rim has corroded. The tire must be removed from the rim before the rim can be cleaned. While the tire is removed, the repair person will check the tire bead to ensure it is not causing the leakage.

(c) Punctures

Air leakage in tires is usually the result of punctures. The best place to get a punctured tire fixed is at a tire repair shop.

There are some spray-can-type do-it-yourself puncture repair kits available. These contain liquid sealant with enough air under pressure to reinflate the tire. These repair kits work on smaller punctures where the object does not stay in the tire. Where the puncturing object stays in the tire, the sealant will seal around the object and harden. Later, if the object is removed from the tire, the puncture will leak.

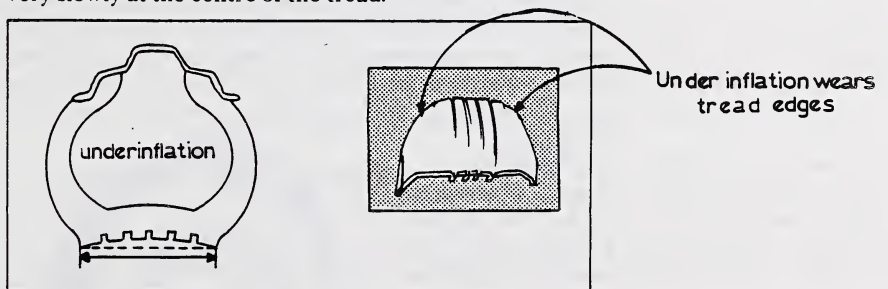
Large punctures, punctures close to the sidewall, or punctures on the sidewall, should not be repaired. A replacement tire is best as far as safety is concerned.

4. Tread

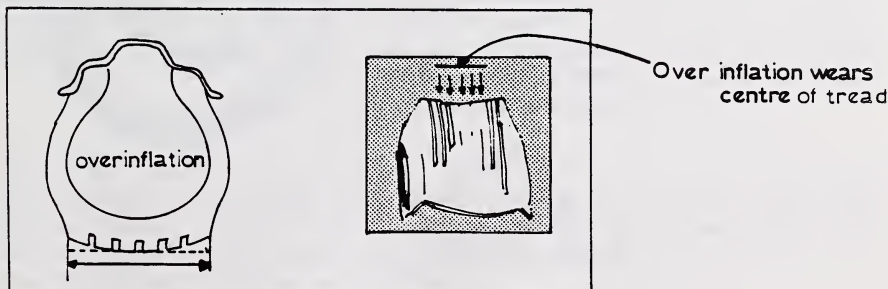
The patterns that are formed on the tread surfaces of tires as they wear can indicate many things about the tire or the condition of the car. They can tell how well the tires were looked after as far as air pressure is concerned, how well the wheels were aligned, or how well they were balanced.

(a) Tire Inflation

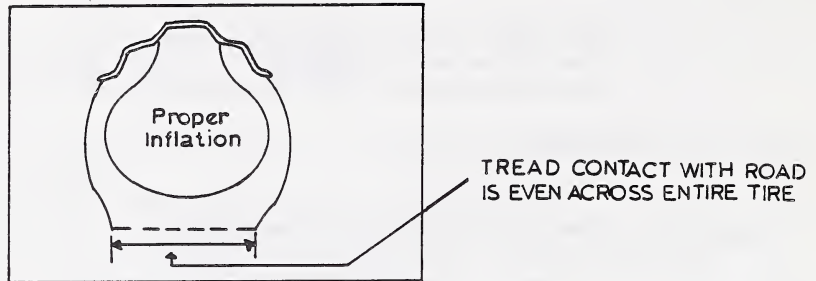
Tires which are run low on pressure wear quickly on each edge of the tread and very slowly at the centre of the tread.



Tires which are overinflated will wear quickly in the centre of the tread and very slowly on each edge.



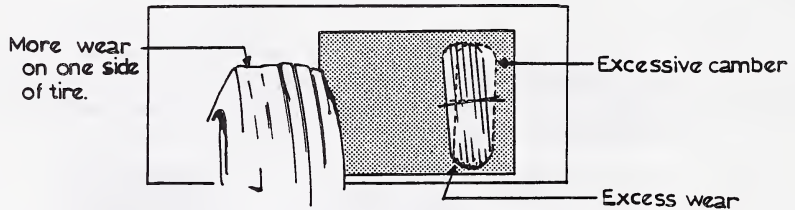
Tires which are properly inflated will run with the tread flat on the road. The tread will wear evenly across the tire width.



Underinflation and overinflation shorten tire life.

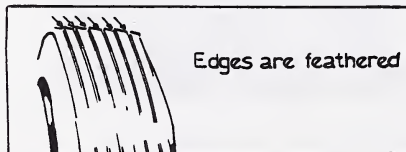
(b) Wheel Alignment

Tires which are worn on one side of the tread more than the other side, indicate that you should have the vehicle's wheels realigned. Wear of this type is caused by excessive camber. This means the tire is not straight up and down in a vertical position, but slanted to one side.



Correcting this problem requires a professional wheel alignment job.

If the edges of the tread are feathered, that is, one edge of each tread bar is worn down more than the other, toe in is off. If the toe in is off, this means both tires are not pointing straight down the road. Again, this repair requires a wheel alignment to correct it.



(c) Wheel Balancing

When you look at a tire and it has numerous dips or worn spots scattered around the tire tread, the wheel balance is off. Balancing is a job for a tire shop since special equipment is required.



5. Changing Tires

Many people dread a flat tire because they believe it is difficult and complex to change a flat tire. This is not the case. With the proper equipment and a knowledge of the procedure, tire changing should be relatively easy.

The first step when a flat tire occurs, is to ensure the vehicle is in a location where it does not obstruct traffic or create a hazard to yourself or other drivers. Pull to the side of the road, well off the travelled portion. Make sure though that you are not on a side slope as the car may slip off the jack as the car is raised. A car can usually be driven a short distance at low speeds without damage to the tire.

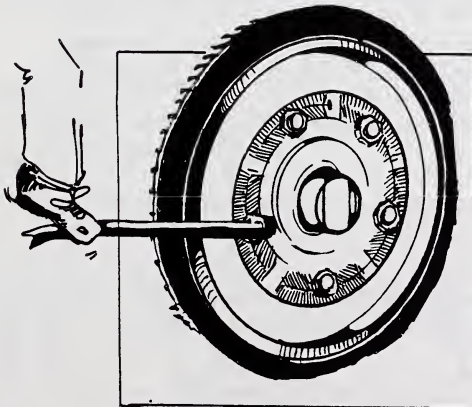
Once a suitable location has been found, place the transmission in low gear if a manual type and in park if an automatic. Firmly set the emergency brake.

Locate the tire changing tools. These are found in the trunk of most cars. You will need a jack, a tire wrench, and of course, your spare tire.

Below is the procedure for changing a flat tire on a car. As trucks and vans are larger and can have a heavy load in them, the tire changing procedure and equipment to be used is slightly different. For trucks and vans refer to your operator's manual for changing a tire. The procedure listed below is quite general so always read the directions given in your operator's manual first. Its description covers the important points concerning your car's tires and may cover certain procedures (e.g. safety) in more detail.

The steps for changing a tire on a car are as follows:

- (a) Remove the jack, tire wrench, and spare tire from their holders in the vehicle.
- (b) Remove the hub caps from the wheels. The sharpened end of a tire wrench works well in removing hub caps.
- (c) Brush or wipe away dirt from the threads which are visible.
- (d) Loosen each of the wheel lug nuts one half to one full turn. Do this before raising the car. The lug nuts on all newer cars are turned counterclockwise (opposite the way clock hands turn) in order to loosen them. This type of thread is called a right hand thread.



If the lug nuts are difficult to loosen, try positioning the wrench on the lug nut so it is in a horizontal position. Then step down hard on the end of the wrench. A sudden blow is required. This should make loosening the lug nuts easier.

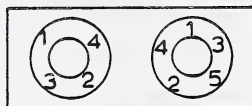
As you break the lug nuts loose, they should start to turn easier. If not, you may have to turn them the opposite way. Some older cars did have lug nuts on the left side of the car which had left-hand threads and were loosened by turning them in a clockwise direction.

- (e) Once the lug nuts are broken loose, position the jack so it is placed in the proper location. On some cars this is on the bumper while on other cars, the jack notch is on the side of the car. Check the directions on a label in the car's trunk or in your operator's manual to be sure which procedure to follow.

Insure the jack is placed so it is straight up and down. Once the jack is positioned correctly, raise the vehicle so the tire clears the road by enough to remove the flat tire and reinstall the new tire. **Never crawl under a vehicle supported by a jack alone.**

- (f) Remove the lug nuts from the wheel. Pull the flat tire off and set it aside. Place the spare tire over the studs. It is best not to put a hand or foot directly under the spare tire while installing it, just in case the jack slips.
- (g) Once the spare tire is in place, replace all lug nuts. Insure the cone-shaped end of the lug nut goes on first. Tighten them lightly with the tire wrench.
- (h) Lower the vehicle and remove the jack.
- (i) Complete tightening of the lug nuts securely. To insure the lug nuts are properly tightened, a torque wrench should be used. If one is not available at the time of the tire change, check the torque as soon as possible afterwards. Service manuals will give the proper torque. Use the tightening sequence shown below whenever tightening lug nuts.

Proper Tightening Sequence



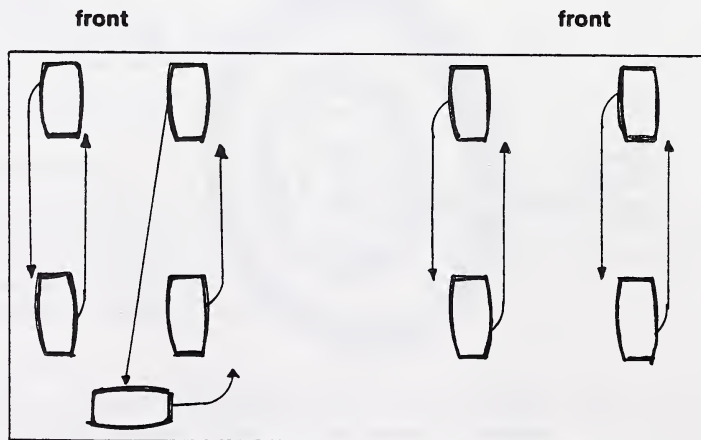
Tighten the wheel nuts in the order shown above to prevent stress buildup. Stress can crack the wheels.

6. Tire Rotation

Tires should never be mixed. If you are putting radial tires on your car, then buy five of them. This same rule applies to bias-ply tires and bias-belted tires as well. Again, **never mix tires.**

To get maximum life from your car tires, they should be rotated at proper intervals. Check your owner's manual for the proper rotation schedule for your car.

The proper system to use for rotation of **radial tires** is given in diagram form below.

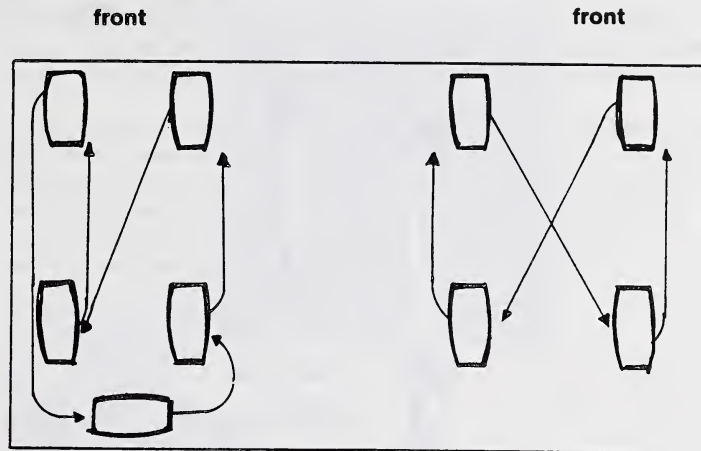


5-wheel radial tire rotation

4-wheel radial tire rotation

Note that radial tires should always be placed on the same side of the car. Do not switch radial tires across or diagonally.

The system for **bias-ply** and **bias-belted** tires is shown below.



5-wheel bias-ply and bias-belted tire rotation

4-wheel bias-ply and bias-belted tire rotation

COOLING SYSTEM

Engines are approximately 30% efficient. This means they use only 30% of the heat value contained in the fuel. Another 30% of the heat value is carried away in the exhaust. The remaining 40% of the heat has to be dissipated by the cooling system. Without a cooling system, the engine would quickly overheat and seize.

In a water-cooled engine, a liquid is used as a coolant. Water by itself is not used as a coolant for several reasons. One of these reasons is that it freezes at a temperature much above our normal winter temperatures. If pure water freezes in a radiator or engine block, it will expand and crack the radiator or engine block. Another reason why water is not used is because it boils at too low of a temperature. If pure water is used in a modern car engine, it may boil at normal operating temperatures. A third reason pure water is not used is because it can lead to corrosion.

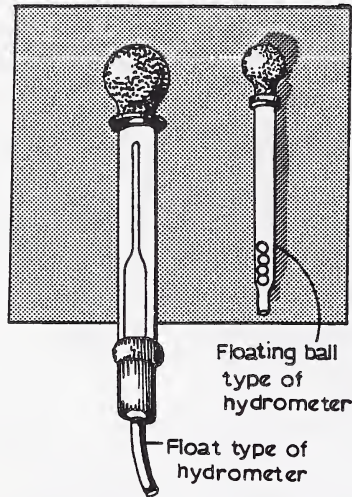
Modern-day coolants are a mixture of water and ethylene glycol antifreeze. These coolants will do three things:

- (a) The ethylene glycol antifreeze lowers the freezing point of the water to a level below the lowest temperatures encountered.
- (b) The ethylene glycol antifreeze raises the boiling point to a level above the operating temperature of the engine. The more antifreeze that is added to coolant, the higher the boiling point of the coolant will be.
- (c) The ethylene glycol antifreeze contains rust and corrosion inhibitors.

1. Special Tools Required

(a) Hydrometer

An antifreeze tester, or hydrometer, is required to test for the freezing point of the coolant. The hydrometer measures the specific gravity (density) of the coolant.



The greater the specific gravity of the coolant (antifreeze is more dense than water), the greater the resistance to freezing.

50% antifreeze, 50% water freezes at -35°C

68% antifreeze, 32% water freezes at -64°C

This is the lowest possible freezing point for water and antifreeze. More than 68% antifreeze would mean an increase in the freezing point. For example, pure ethylene glycol (100% solution) freezes at -23°C .

For Alberta's extremes of temperature, 50% to 60% ethylene glycol antifreeze is recommended.

2. Supplies

Before working on the cooling system, it is necessary to have a supply of new antifreeze on hand. For most cars two four-litre containers would be more than enough.

Another item which is necessary is a drain pan. Antifreeze will stain concrete floors, therefore, you should try not to spill it.

If the fan belt is in bad condition (e.g. frayed or torn), this would be the time to purchase a new one and install it.

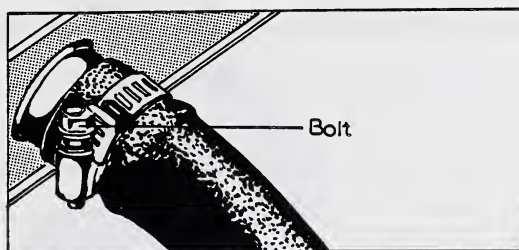
3. Checking for Leaks

Before testing or changing antifreeze, it is best to give the cooling system a complete check. These checks involve looking for: leaks, swollen or collapsed hoses, poor fan belts, etc. It is a waste of money to put new antifreeze into a system which leaks.

(a) Procedure

There are many locations which required checking for leaks before the cooling system can be considered in satisfactory condition.

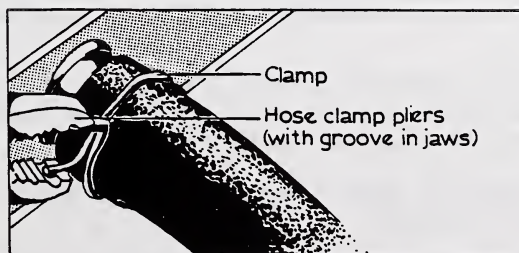
- (i) The radiator can be quickly checked. Look for any sign of wetness on the radiator core. Also look for any sign of whiteness or white spots. The whiteness is a sign of coolant leaking. Repairs should be made prior to refilling with new antifreeze.
- (ii) Check all hoses and hose connections. It is important to examine the clamped ends of all hoses for wetness. Other parts to check are the upper and lower radiator hoses, the two heater hoses, and the water pump bypass hose. If there is any sign of wetness, the hose clamps will have to be tightened. If a hose clamp will not tighten, it should be replaced. Replace hose clamps with good quality stainless steel hose clamps. (Worm-drive ones are the best.)



Also check the hoses for signs of swelling. Most hoses, as they deteriorate, tend to soften and swell. Swollen hoses should be replaced. Blown hoses after all, can lead to a sudden loss of coolant and engine overheating, resulting in major damage.

The lower radiator hose is the suction hose for the water pump. Once it softens, the water pump suction can cause the hose to collapse. If this happens, the water pump will not receive any water and the engine will overheat.

Hoses can be easily replaced by the home handiperson. The first step is to remove the hose clamps. The factory supplied clamps are usually spring-wire clamps. These require the use of a pair of pliers to compress them. Care should be taken to keep fingers away from the clamps. If they slip out of the pliers once compressed, they can seriously injure a finger.



Once the clamps are removed, an attempt can be made to remove the hose. Do not pull too hard on the radiator as, the outlet tube from the radiator could be cracked. If the hose is stuck, you can very carefully slice the hose lengthwise for approximately 5 cm at each end. Once sliced, it should come off very easily.

It is best to use new clamps for a new hose. Slide one of the clamps onto the hose and then push the hose onto the fitting. Repeat this procedure for the other end. Tighten the two hose clamps securely.

- (iii) Check other areas for leakage such as around frost plugs in the side of the engine block and gaskets where the water pump bolts to the engine block.

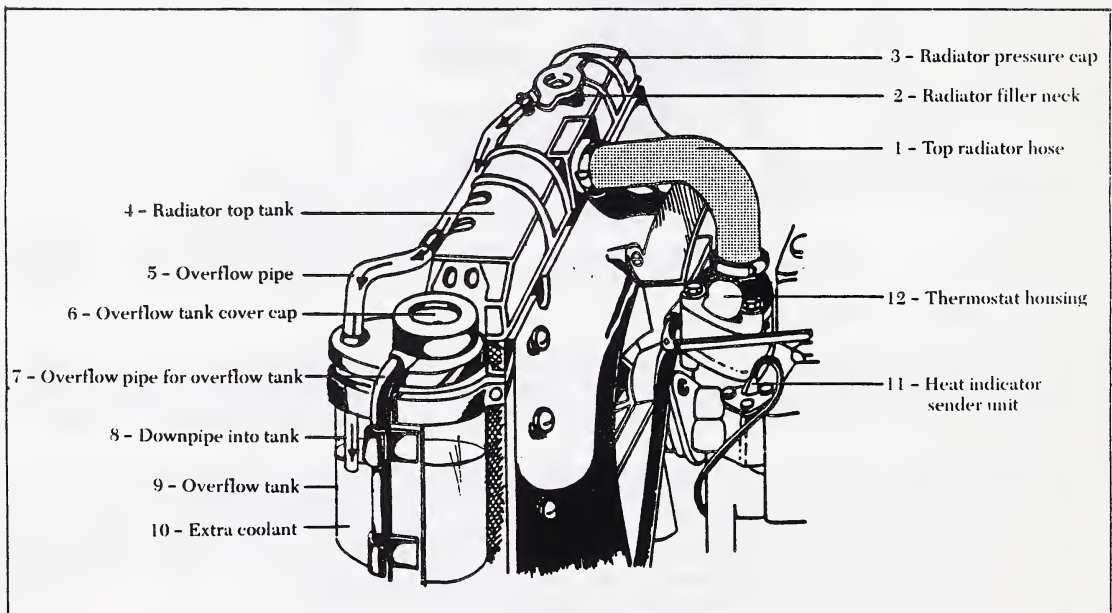
4. Changing the Thermostat

Thermostats can easily be changed, when necessary, at the same time a coolant change is being done. The coolant has to be partly drained before removing the thermostat.

Signs of a thermostat that is not working are: only warm air coming from the heater, low needle position on the temperature gauge or cronic overheating of the engine.

If a thermostat replacement job is to be done, it is necessary to first obtain a thermostat and gasket from an automotive parts supplier. Once a thermostat and gasket is obtained, the replacement job can be attempted.

The thermostat is located where the upper radiator hose joins the block of the engine.



The upper radiator hose is clamped to a housing which holds the thermostat in place on the engine. There are two or three bolts holding this housing to the engine block. A socket wrench will be required to remove these bolts.

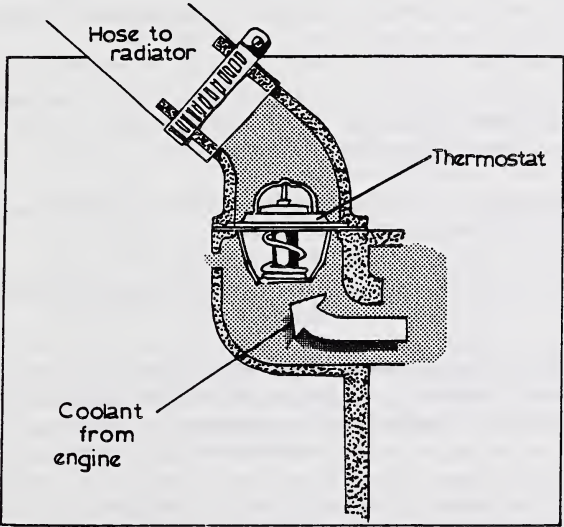
Once the bolts are removed, the housing can be lifted upward to expose the thermostat. Remove the thermostat.

It may be necessary to loosen the radiator hose so that the housing can be turned to face upward.

The gasket surfaces of the housing and the engine block will have to be cleaned thoroughly before reassembly. The best tool for this job is a gasket scraper. An old wood chisel or plane blade will work provided they are sharp and free of burrs. However, damage to the wood chisel or plane blade may result. If not properly cleaned, the housing will leak.

Once the cleaning job is done, you are ready to install the new thermostat. Look carefully at the engine block and the thermostat housing. One of them should have a ledge around the inner edge of the opening. This ledge holds the flange of the thermostat. The gasket cannot be placed over this ledge unless the thermostat is in place since the hole in the gasket may not be large enough to allow the thermostat flange through it.

The thermostat must be installed correctly. The spring or bellows portion must be placed towards the engine block or cylinder head. Failure to install the thermostat correctly will lead to overheating of the engine.



Install the thermostat housing onto the engine and tighten the bolts. Where the thermostat is on the front of the engine, make sure the flange on the thermostat has not slipped between the housing and the cylinder head. If this happens, it is possible to crack or break the thermostat housing. You can check to see if this has happened by finger tightening the bolts on the housing and then visually checking to see if the thermostat housing is flat against the cylinder head. If the thermostat has slipped out of place, there will be a gap between the lower portion of the housing and the head.

Use a torque wrench to complete tightening the bolts to the proper specifications. Check for the proper torque in the service manual or on a bolt torque chart.

5. Checking Antifreeze Strength

°Celsius	Protection Against Freezing					Protection Against Boil-Over°				
	-24	-37	-44	-52	-64	125	128	129	131	136
% Antifreeze	40	50	55	60	68	40	50	55	60	68
% Water	60	50	45	40	32	60	50	45	40	32

°With a 100 kPa (15 p.s.i.) radiator cap in good condition.

Nothing more or less than the mixtures shown in this chart should be used. A 50-50 ratio is good for most driving conditions.

A decision has to be made at this point. Do you want to check the antifreeze strength, and if satisfactory, leave it in for another year, or do you want to change the antifreeze? It is no use checking antifreeze strength if you are going to change it.

Most sources recommend changing antifreeze every two years. This is primarily because the corrosion inhibitors in antifreeze wear out. This could lead to corrosion in the engine. If you want to change antifreeze, Section 6 of this lesson will explain the procedure.

An antifreeze test (hydrometer) is required to test antifreeze strength. The best ones have a thermometer on them so that the temperature of the coolant can be taken into account. Readings will vary as the temperature changes and hence the need for temperature correction.

Testers without thermometers are accurate at only one temperature. For this reason, it is important to read the hydrometer directions to find out whether to check the coolant strength while the engine is hot or cold.

Antifreeze strength should be checked whenever new antifreeze and/or water has been added (this is especially true in winter).

Under central Alberta winter conditions, a -40°C rating is acceptable.

Why is this much protection required? To elaborate further, say our car is left idling or you are driving slowly on an extremely cold day. The radiator will be cooling the solution much faster than the engine is heating it. So ice crystals begin to form in the lower radiator tank and the lower hose. This buildup continues until the pump can no longer draw coolant and that which is in the engine stops circulating and, as a result, gets hot enough to boil. On the other hand, if the engine is parked and shut off, then the crystals will also form in the lower passages of the block and water jacket. No serious damage can result from the ice crystals alone. Say you only have a 10% strength of glycol in the system. This is only good to a temperature of about -10°C . You now have a mixture of 90% water which freezes and fills the cooling system with ice crystals. You cannot drive the car because it will boil very easily, but NO damage should result from the freezing of this 10% solution at any temperature colder than this if the vehicle is not operated. If the vehicle is operated with coolant which cannot circulate, serious damage could result from the boiling away of the coolant.

6. Changing the Coolant

There are two ways of changing coolant depending on the condition of the cooling system and the accessibility of the drain plugs. Choose the one which suits your needs. In order to choose, you should check the cooling system for corrosion. This can be done by removing the radiator cap and running a finger around the inside of the filler neck. If your finger is covered with greasy deposits or rust, the system will need flushing.

- (a) If the coolant appears clean and there are no deposits inside the filler neck of the radiator, the coolant needs only to be completely drained and replaced.

The first step in the coolant change procedure is to locate the coolant drain petcock in the bottom portion of the radiator. A rubber hose can be attached to the draincock to direct the coolant into a container. Open the petcock to drain the coolant. Remove the radiator cap to allow air into the radiator to speed draining. Some cars have no drain petcock in the radiator. In these cases, remove the lower radiator hose where it attaches to the radiator to let the coolant drain.

The second step in the procedure is to locate the drain plug or plugs on the side of the engine block.

On a four or six-cylinder in-line engine, the plug will be located close to the bottom of the engine block. It will be in the centre portion of the engine (from front to back) and just above where the casting starts to widen out.

When removed, additional antifreeze should flow out. If not, check to see if the hole is plugged with corrosion. A heavy wire poked into the hole will clear it if plugged.

If oil drains from the hole when the plug is removed, you have removed the wrong plug. Replace this plug and thoroughly tighten it. Look for another plug.

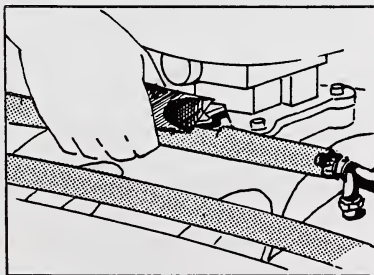
Some cars do not have a coolant drain plug in the block. On these vehicles, follow procedure (b) below to remove coolant from the block.

Once the coolant has thoroughly drained from the radiator and block, there will still be a small amount of coolant left in the heater and heater hoses. This can be left in the system, but it will contaminate the new coolant slightly. This is not a major problem if the old coolant was relatively clean. You can, however, flush this remaining coolant by closing the radiator petcock (or replacing the lower radiator hose) and reinstalling the drain plug. Refill the cooling system with water and run the engine for several minutes with the heater on high. Redrain the cooling system. Finally, reinstall and tighten the drain plug and the radiator petcock (or lower radiator hose).

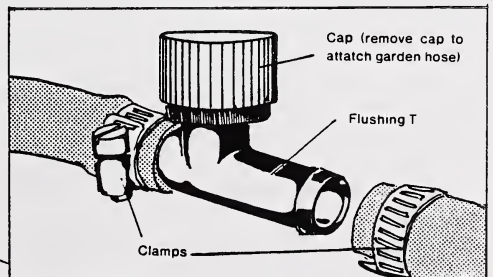
To refill the coolant system it is necessary to know how much coolant is required. Check your owner's manual to find this information. Next, check the chart on the antifreeze container to find the amount of antifreeze required to give you the desired temperature protection.

Add the antifreeze first and then enough clean water to fill the system. Slightly less water will be required than antifreeze, but remember there will be some water in the heater and heater hoses.

- (b) When the coolant appears dark and/or there are deposits inside the radiator filler neck, the cooling system should be flushed. This will require the installation of a flushing "T." The flushing T is installed in the heater hose which runs from the engine block to the heater. This is the heater inlet hose. Do not connect a flushing T to the heater hose which runs from the water pump.



Cut hose



Install flushing T

Attach a garden hose to the flusing T, set the heater controls to hot, remove the radiator cap, and run the engine for five minutes with the water on. The car heater fan should be set on maximum while doing this.

If the system is heavily corroded, flushing with water alone may not remove all of the corrosion. In this case, first the system should be flushed as stated on page 15. Next, the garden hose should be removed and the flushing T closed. A commercial radiator cleaner or flushing chemical (available at automotive parts supply stores) should be added. Operate your car's engine for the length of time specified by the chemical manufacturer. Then stop the engine.

The garden hose can now be reconnected. Do not reconnect the garden hose with the engine running as hot water may spray out. Restart the engine and flush for five more minutes.

Once the reflushing is done, stop the engine, remove the garden hose, and open the drain petcock in the radiator (if there is no drain petcock, remove the lower radiator hose from the radiator) to drain the radiator. Once drained, close the petcock (or reattach the lower radiator hose).

Add the antifreeze. To determine the correct amount, see part (a) on pages 14 and 15. Leave the flushing T open for additional water to drain out. This will help insure enough water drains out to get the required amount of antifreeze into the cooling system. Close the flushing T when the solution changes color, as this means antifreeze has reached the flushing T and is draining out.

COMPLETE THE FOLLOWING EXERCISES AND SEND THEM IN FOR CORRECTION.

EXERCISE 1

1. What are the two main functions served by tires?

(a) _____

(b) _____

2. You may see the figures **P 205/75R15** on the side wall of a tire. What do each of the following indicate?

P _____

205 _____

R _____

75 _____

15 _____

3. Some tires are of the tube type. What does this mean?

4. What are two major reasons why tire pressure should be checked monthly?

(a) _____

(b) _____

5. Briefly explain the procedure to be followed for stopping a leak in a tire valve.

6. What is the likely reason why a tire would wear quickly in the centre of the tread?

7. What does the term "camber" mean?

8. When tires are out of balance, numerous dips or wear spots form around the tire. Why do these dips form?

9. What is the best method of breaking loose wheel lug nuts when you are not strong enough to turn the tire wrench by hand?

10. What will likely happen if you jack a vehicle up before breaking loose the lug nuts?

11. Why is it important to tighten lug nuts in the proper sequence?

12. Front tires wear at the edges due to cornering. Rear tires usually wear more in the centre. What can be done to gain maximum tire life?

EXERCISE 2

1. Why would you never use a coolant mixture of 75% ethylene glycol and 25% water?

2. Why should antifreeze be tested only at the engine temperature specified by the manufacturer of the hydrometer used?

3. Before changing coolant, the cooling system is usually thoroughly check over. Why?

4. Why should hoses which are swollen be replaced?

5. Why does the lower radiator hose usually have a reinforcing wire inside it?

6. What type of hose clamps are considered best?

7. List three problems encountered in a cooling system which point to a faulty thermostat?
 - (a) _____
 - (b) _____
 - (c) _____
8. Why is it important to carefully clean the gasket surfaces on the head and thermostat housing when replacing a thermostat?

9. What is likely to happen if the thermostat is installed backwards?

10. Why should you always use a torque wrench to retighten bolts after a repair job?

11. How do you determine when a cooling system needs a thorough flushing?

12. Why is flushing a cooling system considered superior to just draining it?

LESSON RECORD FORM

5039 Automobile Maintenance

Revised 88/06

FOR STUDENT USE ONLY

Date Lesson Submitted

(If label is missing
or incorrect)

File Number

Time Spent on Lesson

Lesson Number

FOR SCHOOL USE ONLY

Assigned
Teacher: _____

Lesson Grading: _____

Additional Grading
E/R/P Code: _____

Mark: _____

Graded by: _____

Assignment Code: _____

Date Lesson Received:

Lesson Recorded _____

Student's Questions and Comments

Apply Lesson Label Here

Name

Address

Postal Code

Please verify that preprinted label is for
correct course and lesson.

Teacher's Comments:

Correspondence Teacher

ALBERTA DISTANCE LEARNING CENTRE

MAILING INSTRUCTIONS FOR CORRESPONDENCE LESSONS

1. BEFORE MAILING YOUR LESSONS, PLEASE SEE THAT:

- (1) All pages are numbered and in order, and no paper clips or staples are used.
- (2) All exercises are completed. If not, explain why.
- (3) Your work has been re-read to ensure accuracy in spelling and lesson details.
- (4) The Lesson Record Form is filled out and the correct lesson label is attached.
- (5) This mailing sheet is placed on the lesson.

2. POSTAGE REGULATIONS

Do not enclose letters with lessons.

Send all letters in a separate envelope.

3. POSTAGE RATES

First Class

Take your lesson to the Post Office and have it weighed. Attach sufficient postage and a green first-class sticker to the front of the envelope, and seal the envelope. Correspondence lessons will travel faster if first-class postage is used.

Try to mail each lesson as soon as it has been completed.

When you register for correspondence courses, you are expected to send lessons for correction regularly. Avoid sending more than two or three lessons in one subject at the same time.

MINOR CHECKS, ADJUSTMENTS AND REPAIRS**Lubricating Body Parts****Air Cleaner****Windshield Wipers****Clutch Adjustment****Belts****Fuel Filter****Exhaust Leaks****De-icing Locks****P.C.V. Valves****Replacing Lights****Introduction**

Many of the small problems of a mechanical nature encountered in the operation of a vehicle can be repaired by the do-it-yourselfer. Tasks such as repairing squeaks and rattles, checking the condition of belts, cleaning air cleaners, etc. involve relatively simple procedures and in the long term can save the car owner considerable amounts of money.

LUBRICATING BODY PARTS

All of the moving parts of a car body should be lubricated at least twice a year (more often under severe conditions). Doors, hoods, etc. can be damaged if they seize and then are forced open or closed. Squeaks caused by lack of lubrication are annoying as well.

The following parts can be lubricated with engine oil, white grease, or a pressurized spray lubricant:

1. door hinges and catches;
2. hood hinges and catch;
3. trunk hinges and catch.

Nylon or plastic parts are not usually lubricated. Consult your owner's manual for the carmaker's recommendations.

Apply the lubricant where one part comes in contact with another part or where the parts pivot. Do not apply too much lubricant.

In areas where clothing may come in contact with the lubricant, use a non-staining water-proof white grease.

Door locks are lubricated with silicon spray or graphite-based lock lubricant. Do not use oil on a lock cylinder as it may make the lock sticky or hard to operate. Oil will also attract dust whereas silicon spray or graphite will not.

The lubricant is sprayed in through the key opening in the lock. On locks which have a seal, use the tip of the key to hold the seal open as you insert the lubricant. To distribute the lubricant, insert the key and work the lock several times.

Hinges on sun visors, the glove compartment door, and the rear license plate holder can be lubricated with pressurized spray lubricants.

WINDSHIELD WIPERS

Windshield wipers are intended to keep the windshield clear in wet conditions. Good wipers are essential for safe driving. For the wipers to work efficiently, keep the windshield and wipers clean by washing them when necessary.

Three items which can affect the operation of windshield wipers are: the rubber squeegees, the wiper-blade assembly, and the wiper arms.

Some common problems are shown below. Each of these has an explanation of the possible cause. Remedies will be explained later.



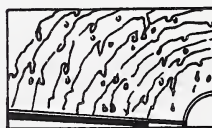
A dirty windshield or wipers, insufficient solvent or antifreeze in the washing solution, or worn-out squeegees can cause **SMEARING**. Try cleaning the glass and wipers and adding the correct amount of solvent in the summer or antifreeze in the winter, before replacing the squeegees.



When the squeegee does not flip back and forth, **SMEARING IN ONLY ONE DIRECTION** occurs. Because this can be caused by extreme cold, expose squeegees to warm air or rinse them in warm water. If the squeegees are age-hardened, replace them. Squeegees of the wrong size can also cause this problem.



A bent wiper arm or frozen squeegee can cause **CHATTERING**. If the bent arm cannot be straightened so that it remains parallel to the glass, replace it. A frozen squeegee is corrected as described above.



Buildups of grease, oil, wax, or silicon cause **WATER BEADS** on the glass. Windshields and wipers can be cleaned thoroughly with clean rags dipped in the solvent normally used to clean grease and silicon from bodywork before painting. Ensure that no trace of solvent remains by thoroughly rinsing the windshield and wipers.

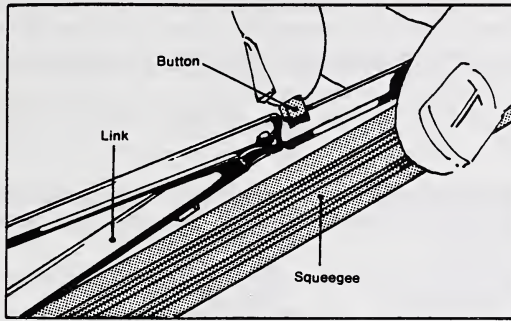
1. Wiper Squeegee

When the problem is the wiper's squeegee, the squeegee has to be replaced. Squeegees have to be flexible enough to follow the contours of the glass and have sharp enough edges to cut through water cleanly. Weather, time, and air pollution all affect the squeegee. They tend to make it hard, brittle, and inflexible. Generally, squeegees should be replaced once a year. Replacement elements (refills) are available at most automotive parts stores.

There are three types of clamps used for holding the squeegee to the wiper blade assembly.

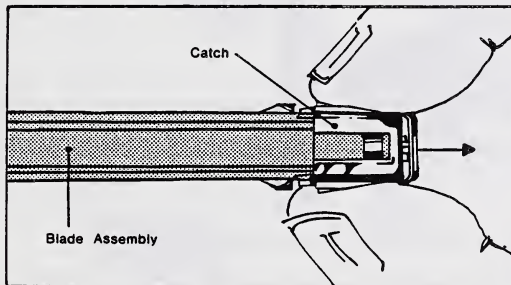
(a) Anco Type

Push the red button on either one of the wiper's links. Pull the squeegee along with the released link until it is free. Next, pull the squeegee out of the link. Thread the refill through the free link and then through the link still attached to the wiper blade assembly. Snap the free link back into place.



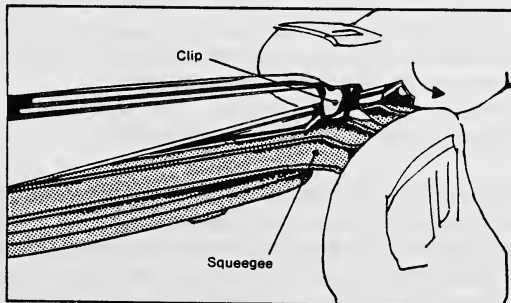
(b) Trico Type

Squeeze the sides of the spring-catch together and pull the squeegee out. Feed the end of the refill without the spring-catch onto the blade assembly first. Push on the end of the squeegee with the spring-catch until the catch snaps into place.



(c) Clip-On Type

Squeeze the ends of the squeegee and twist them free of the retaining clips. Slide the squeegee out. Keep the steel reinforcing strips and fit them into the grooves of the refill. Slide the refill into the blade assembly. Twist the refill until the clips engage the holes in the squeegee.



2. Wiper-Blade Assembly

If the problem is with the wiper-blade assembly, a replacement can easily be purchased from an automotive parts supply store. Wiper-blade assemblies distribute the downward pressure evenly along the entire length of the squeegee. If the metal is bent or corroded on the wiper-blade assembly, downward pressure on the squeegee may be uneven, causing missed or streaked areas on the glass.

Some wiper-blade assemblies include squeegees as well, so check to see if they are included or whether they will have to be purchased separately.

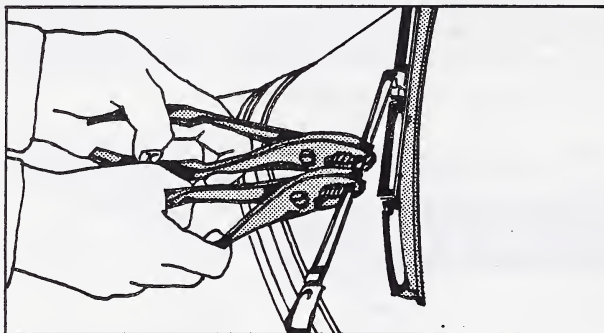
As there are many styles of connectors for holding wiper-blade assemblies to the wiper arms, the procedure will not be covered in this course. Instead, refer to directions on the package or your car's service manual for the appropriate procedure.

3. Wiper Arms

Wiper arms very seldom cause any problems. If they are found to be faulty, they can be replaced or possibly repaired. Problems include bent arms and corroded or broken springs.

Bent wiper arms can result in damage to the squeegee if the squeegee hits the molding on the edge of the windshield.

Wiper arms can be straightened in some cases by the use of two pairs of pliers.



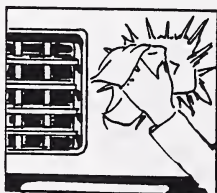
To bend the wiper arms, turn the ignition switch and the wiper switch on. Turn the ignition switch off when the wipers are in the vertical position. Look carefully at the wiper arms to determine where they are bent. A wiper arm should be parallel to the glass and the squeegee perpendicular to the glass at mid-stroke.

To straighten the arms, grasp the arm with two pairs of pliers and twist until it remains parallel to the glass.

Arms with broken or corroded springs must be replaced. A corroded spring will be weak and not put enough downward pressure onto the squeegee.

4. Windshield and Wiper Tips

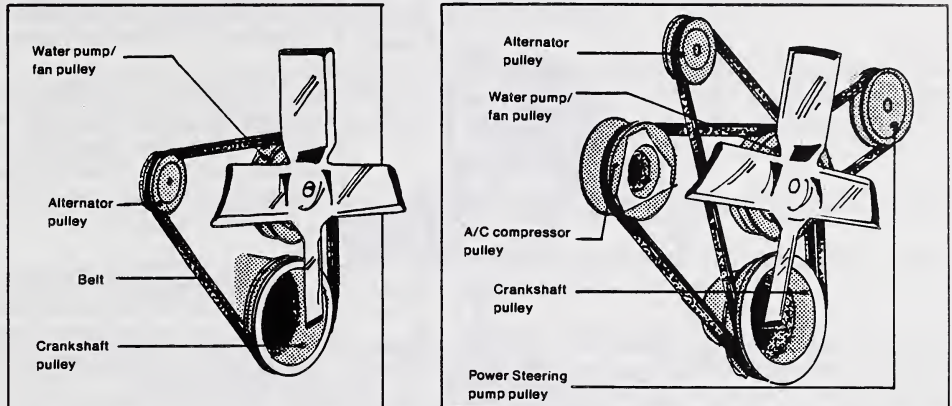
Occasionally, your wipers will clog with a buildup of snow or ice. If you cannot find a safe spot to pull off the road, open the side window. Place your hand onto the windshield and let the wiper run up onto your fingers. Flip the wiper away from the glass. When the wiper snaps back down, the ice will crack and fall off the rubber.



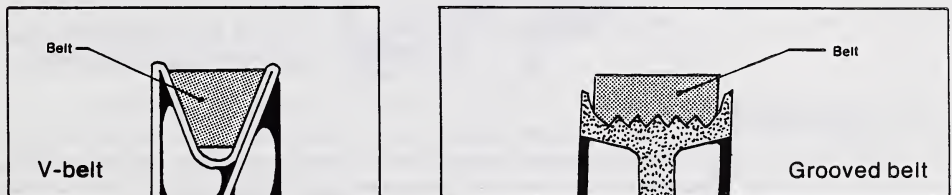
At night, as ice and road dirt buildup on the lenses, your headlights may become dimmer. Stop every so often to clean off your headlights, taillights, and side marker lights. At the same time, clean off the rear and side windows and the edges of your windshield.

BELTS

Drive belts are used to operate various accessories such as the fan, waterpump, power-steering pump, air-injection pump, and alternator. Sometimes one belt will drive two or more accessories, while on other vehicles two or more belts are used.



Drive belts come in two styles. One style is the V-belt and the other is the grooved belt.



The most common type of drive belt is the V-belt.

1. Checking the Condition of Drive Belts

WARNING: On vehicles with an electrically driven fan, the fan can turn on unexpectedly even with the ignition switch turned off. Be especially wary of a electrically driven fan with a warm car engine. Disconnect one lead of the battery before commencing any work.

Drive belts will not last indefinitely and hence should be checked every month or two. If a drive belt breaks, it could leave you stranded. For example, if the belt driving the water pump breaks, the coolant will no longer be circulated and the engine will overheat.

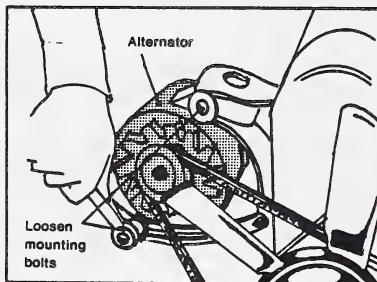
To check the condition of a drive belt, look at the sides and the bottom of each belt in several places. Replace a belt which is cracked, brittle, oil soaked, or slippery.

2. Replacing Drive Belts

Due to the variety in styles of tensioners used to keep drive belts tight, it is best to refer to the service manual for the exact procedure to replace drive belts.

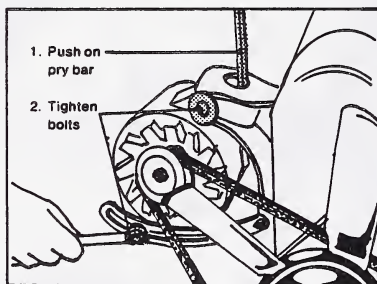
The following notes will discuss the procedure for changing a belt on cars with one drive belt turning a water pump and an alternator. This is the easiest system to work on.

If you can determine how the tensioner works to tighten or loosen the belt on multiple-belt systems, then the rest of the procedure will be similar. The outer or forward belt will have to be removed on multiple-belt systems before the belt closest to the engine can be removed.



Most single-belt systems use the alternator to tighten the belt. In order to remove the drive belt, the alternator mounting bolts must be loosened.

The tension on the belt can then be released by pushing the alternator towards the engine block. Once the tension has been released on the belt, it can be removed from the pulleys. Make sure you have studied the way in which the belt was positioned on the pulleys. Draw a diagram if necessary.



A new belt is now installed on the pulleys in the same way that the old one was positioned. When the new belt is in place, it will be necessary to pry the alternator outward away from the engine block until the belt has the correct tension.

See the next section of this lesson for a complete description of tensioning the drive belt.

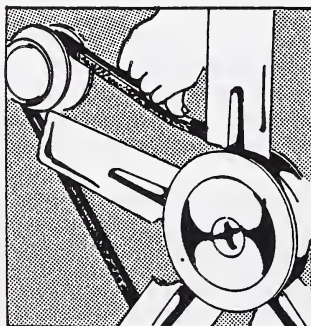
Once the drive belt is tensioned, make sure you tighten all the mounting bolts.

3. Tensioning the Drive Belt

Drive belts have a proper tension that they should run at. Belts which are too tight will wear bearings quickly and not last as long. Belts which are too loose will slip on the pulleys.

It is best to use a belt-tension gauge, as it will very accurately test a belt's tension.

If one is not available, then a less accurate, quick-check method can be used.



The quick-check method is done by pressing down against the belt with your thumb. Do this midway along the longest span between pulleys. If the drive belt deflects more than 1.5 to 2 cm when a force of 110 N (25 lbs) is applied, it is not tight enough.

In order to tighten a drive belt the tension device must be found. For an alternator and water pump operated belt, the alternator is used to set belt tension. For a power-steering drive belt, the power-steering pump is used to set tension.

The first step in tightening a drive belt is to find the bolts which hold the tightener (on the alternator, power-steering pump, etc.) to its mounting brackets. Loosen these bolts. It is not necessary to remove them. The tensioner should then be pushed or pulled to tighten the belt. A pry bar or ratchet may be required as well. Some power-steering pumps have a square slot in the mounting plate to insert a ratchet (or flex handle). If you are in doubt about how the tensioner works on your vehicle, refer to the service manual.

Once the belt has been tightened and checked for proper tension, tighten all the mounting bolts securely. To ensure nothing has moved, recheck belt tension.

EXHAUST LEAKS

Exhaust leaks are hazardous. Exhaust fumes contain carbon monoxide which is a colorless, odorless, but extremely poisonous gas. Any exhaust leakage in the engine compartment or below the car can mean carbon monoxide will filter into the car. Prolonged exposure to even small quantities of carbon monoxide can be fatal.

The exhaust system should be checked constantly for signs of leakage. Listen for unusual noises such as hissing, rumbling, or rattling coming from beneath the car. Excessive noise can mean an exhaust leak (as would any steam or vapor coming from below the car in cold weather).

If a leak is suspected, the complete exhaust system should be checked in order to locate it.

To examine the exhaust system, the car must be raised and supported by jack stands. (See the introduction section of this course for details.)

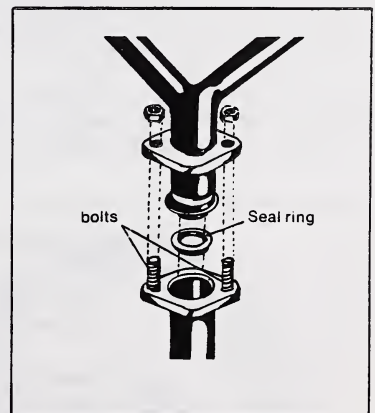
Leaks can occur around the exhaust manifolds. These leaks can be the result of a cracked manifold or a broken seal ring in the manifold to exhaust pipe flange joint. If the leak is the result of a cracked exhaust manifold, the manifold must be removed from the engine. As this procedure differs from engine to engine, refer to the repair manual for your car and follow the procedure given, or take your car to a service station. Exhaust manifolds can be welded if not cracked too badly. This must be done by a professional welder. If the manifold is not repairable, a used one can be purchased from an auto wrecker or a new one can be purchased from an auto parts supplier.

If the leak is the result of a broken sealing ring in the flange joint between the exhaust manifold and the exhaust pipe, a new sealing ring can be purchased and installed. When disassembling the flange joint, use enough penetrating fluid to loosen the rusted bolts. The high heat of the exhaust system corrodes these bolts and makes them extremely difficult to remove. Applying excess force without using penetrating fluid can result in breaking of the bolts.

Once the bolts are removed, the exhaust pipe can be pulled downwards enough to allow removal of the old seal ring and installation of a new one. Once the new ring is in place, replace and tighten the bolts.

Leaks can also occur along the exhaust pipe or in the muffler. Start at the back of the tailpipe and work towards the exhaust manifold. Have a person help you block the exhaust pipe with rags and listen for hisses. Place your hand near any suspected leaking area (do not touch the pipe) and you should be able to feel a jet of gas if the joint or pipe is leaking. If a leak is discovered it should be repaired as soon as possible. Leaky pipes or mufflers are replaced. Replacement of parts by the vehicle owner is possible since mufflers and prebent pipes are available at auto parts stores.

However, it can be difficult to remove old parts. If the original parts are welded together, the old pipe will have to be cut off to be removed. Keep in mind there is a proper place to cut pipes. When removing an old muffler, ensure that small lengths of pipe are removed along with the muffler. The new muffler will have to slide over the existing pipe for approximately 50 to 75 mm and are clamped in place with the proper size muffler clamps, one of which is placed on each end of the muffler.

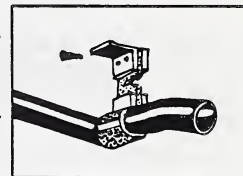


If the tailpipe is to be replaced, only the old tailpipe is removed.

In case the existing muffler is clamped in place, remove the clamps. Again, use plenty of penetrating fluid, as the heat and road salt will have caused corrosion. Place penetrating fluid into the pipe joint as well. Tapping the joint will help loosen it. Do not, however, distort the muffler outlet pipe or the new tailpipe will not fit in place. If the muffler will not break loose from the tailpipe after tapping and twisting, special tools may be required to loosen it.

At the time the exhaust system is checked for leaks, look at the muffler and tailpipe hangers as well.

Grab onto the tailpipe and twist and pull on it to test the hanger straps. Make sure they are solidly attached.



Hangers which are damaged should be replaced. Universal hangers are available at auto parts stores to replace existing hangers.

PCV VALVES (positive crankcase ventilation valve)

The PCV valve is installed on an automobile engine to help control emission pollutants by drawing gases which blow by the piston back into the intake manifold. It is mixed with a new air-fuel mixture and reburned in the cylinders.

A yearly inspection of the PCV valves along with hoses and filters is recommended.

The PCV valve is located in the valve cover or in a hose between the valve cover and the carburetor. If in doubt about the location of the PCV valve, refer to the service manual for your car.

With the engine off the PCV valve can be removed using one of the following methods.

1. If the PCV valve is located in the valve cover, it will be pressed into a rubber grommet. The valve can easily be pulled from the grommet for removal.
2. If the PCV valve is clamped in the centre of a hose, the hose between the PCV valve and the valve cover can be pulled from the PCV valve. A hose clamp may have to be removed.

To check the PCV valve, do **BOTH** of the following checks.

1. Shake the PCV valve. If you cannot hear it rattle, replace it with a new one. If it rattles, proceed to step 2.
2. With the PCV valve connected to the hose leading to the carburetor, and the other end open, start the engine. If you cannot feel a strong vacuum at the open end of the PCV valve, replace it with a new PCV valve. If the valve passes both of these tests, it can be reinstalled on the vehicle.

While the PCV valve removed, thoroughly inspect the hoses. Look for cracks or blockages in the hose. Replace the hose if these problems exist.

Install a new PCV valve if necessary by reversing the procedure used to remove the old PCV valve.

Some cars use a separate filter on the inside of the air cleaner to clean air which is fed into the opposite valve cover (to the one the PCV valve is installed in). This filter should be checked and replaced if it is dirty. Other cars do not have a PCV filter in the air cleaner. Chrysler cars have a filter in the crankcase inlet breather. AMC cars have a filter in the oil filler cap. These filters can be cleaned by removing all hoses, then rinsing the breather or cap in parts solvent (varsol). Allow these to dry before reinstalling.

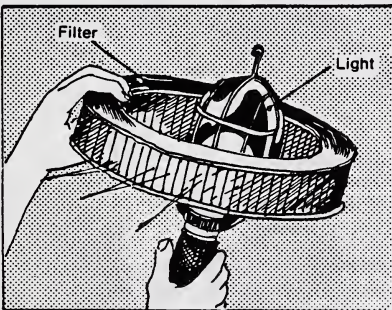
AIR CLEANER

The purpose of the air cleaner (filter) is to remove dust and dirt particles from the combustion air entering the engine. This extends the life of the vehicle's engine.

The air cleaner is either mounted above the engine directly on the carburetor or it is remotely mounted and connected by a large duct to the carburetor or fuel injection system. Trace the large duct from the carburetor to locate the air cleaner.

Air cleaner elements require periodic inspection and cleaning. Check your vehicle's operator's manual for the specified time (or mileage). As a general guide, an air cleaner element should be inspected at least once every 20 000 km. Running your car with a clogged air cleaner could result in stalling and/or excessive fuel consumption because of restricted air intake.

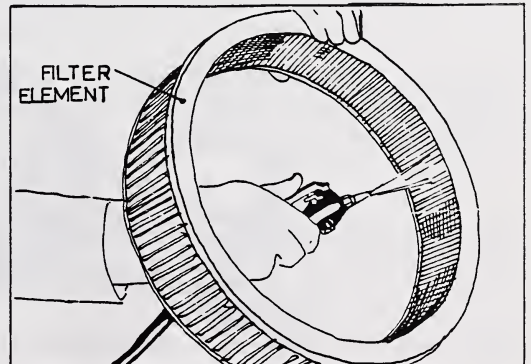
To inspect the air cleaner element, it must first be removed from its protective cannister. Various types of cannisters are used depending on the type of vehicle. It is best to refer to a service manual (or talk to a mechanic) to find out how to remove your air cleaner element. If there are many hoses to disconnect, label the hoses and the nipples to which they are attached.



Once the air cleaner element has been removed, it can be inspected by holding a light (a trouble light will work) inside the filter. While holding the light inside the air cleaner, look at the outside of the filter. If you can see light through the entire filter it is clean and may be reused. If it is slightly dirty, it can be reused after it has been cleaned. If the filter is so dirty you cannot see light through it or it is torn, damaged, or wet, replace it with a new filter.

Most manufacturers indicate the air cleaner element should be replaced every 48 000 km (or more often under dirty conditions).

To clean an air filter element, compressed air is required. The compressed air is blown through the filter in the reverse direction to the normal air flow in order to dislodge dust particles. Always use goggles to protect your eyes when using compressed air to clean a filter.



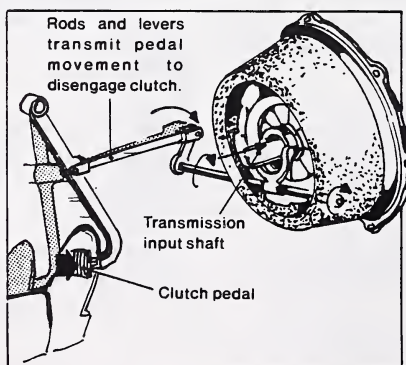
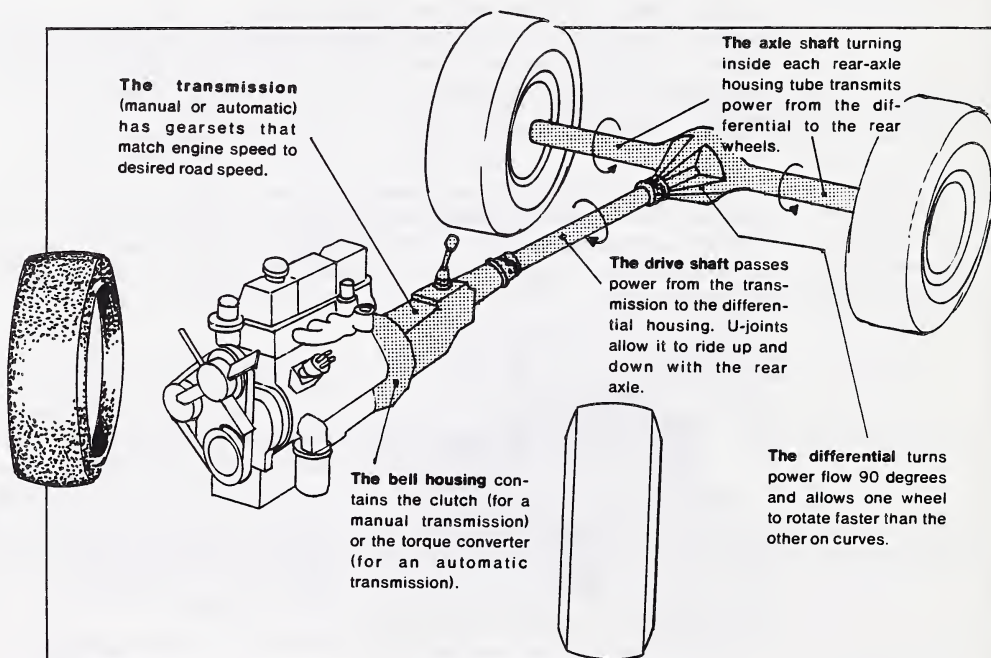
Hold the air blow gun approximately 75 mm away from the inner surface of the air filter. Excess air pressure can damage the filter element. Carefully clean the filter. Try not to miss any part of it. Reinspect the filter after cleaning. If light does not shine through the entire filter after cleaning, replace it.

When the air filter is being reinstalled, ensure that the gasket on the carburetor is in good condition. Any air leakage between the carburetor and the air filter will draw in dust and harm the engine.

CLUTCH ADJUSTMENT

Vehicles which have an automatic transmission, do not have a clutch. Only vehicles with manual transmissions have a clutch. The clutch is used to disengage a transmission from an engine so that the transmission can be shifted from one gear to another. In other words, stepping on the clutch foot pedal disengages the clutch so the engine can run without turning the vehicle's wheels.

The clutch itself is positioned between the engine and the transmission.



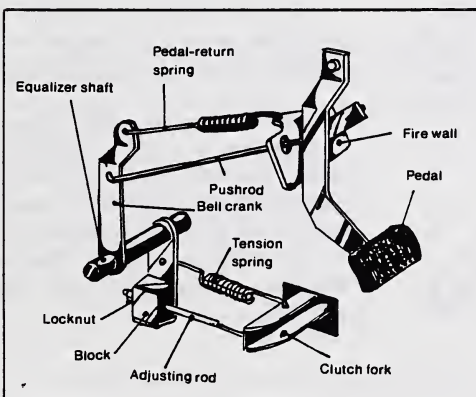
The clutch is engaged or disengaged by the use of the clutch pedal. A linkage of rods, a cable, or a hydraulic cylinder and piston, connects the pedal to the clutch itself.

This linkage must have free play or else the clutch will wear out prematurely. A clutch linkage without free play will not allow the clutch to fully engage. If it is not fully engaged, the clutch will slip and quickly wear out.

The amount of free play in the linkage can be checked at the pedal by pushing the pedal by hand. The pedal should move downward (or inward) approximately 25 mm before resistance is felt. If there is less movement before resistance, the clutch will require adjustment.

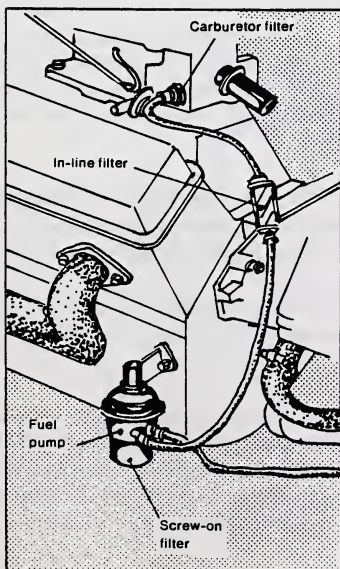
The adjustment for free play is made at the clutch itself. On rear-wheel drive cars the adjustment is usually made from below the car at the clutch housing. This will involve jacking up the car and supporting it on jack stands. On front-wheel drive cars, the clutch can usually be adjusted from the engine compartment.

Due to differences in linkages and adjustment procedures, it is best to use the repair manual for your particular car when adjusting a clutch. This course will only cover the general procedure for the common rod-linkage type clutches.



The clutch pedal forces the bell crank's top arm forward. This in turn moves the lower bell crank lever and the clutch fork rearward. By shortening the adjusting rod, the pedal will have to move downward more before moving the clutch fork enough to start disengaging the clutch. The adjusting rod is adjusted using open-end wrenches (and possibly a vice-grip). Again remember, most cars require approximately 25 mm of free play in the clutch pedal.

FUEL FILTER



All vehicles have a fuel filter. Some have two or even three. The purpose of this filter is to prevent dirt and moisture from entering the carburetor along with the fuel, blocking the tiny fuel passages and affecting engine performance.

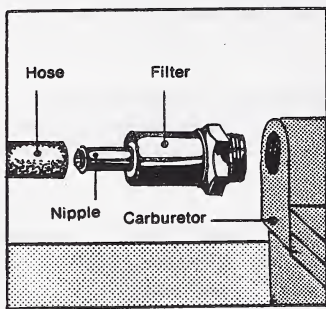
The filters can be located in the carburetor fuel inlet, in the fuel line between the fuel pump and the carburetor, and/or as a screw-on type filter attached to the fuel pump.

Work on the fuel system should only be done once the engine has cooled. Gasoline is extremely flammable and may ignite on a hot engine.

Fuel filters are not serviced, they are replaced with new ones.

Replacement is recommended once every two years.

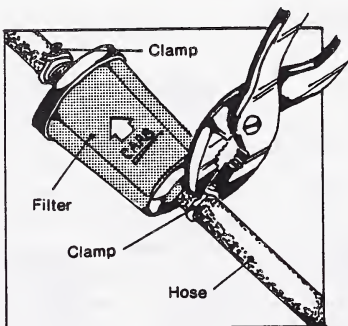
1. Carburetor Inlet Filters



Fuel filters which are built into the carburetor fuel inlet can be removed by loosening the clamp on the fuel line and carefully pulling the hose off the filter.

Once the fuel line has been removed, unscrew the filter from the carburetor. The new filter can now be installed in the carburetor and the fuel line reattached. If the hose clamp or the fuel hose have been damaged, they should be replaced. Run the engine for several minutes and check for leaks.

2. Inline Filters

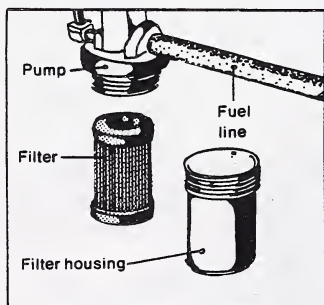


Filters which are installed in the fuel line can usually be removed by taking the clamps off each end of the filter and pulling the hoses from the filter.

Once the old filter has been removed, a replacement one can be pressed into the fuel lines. Install the fuel filter with the arrow on it or outlet end pointing towards the carburetor. The clamps are then replaced in their original position. If the clamps do not securely hold the hose onto the filter, they should be replaced with new clamps of the same size and type.

3. Cannister Style Filter

Some older vehicles have a filter inside a cannister attached to the fuel pump.



The cannister is unscrewed from the fuel pump housing by hand or by using a strap wrench. Once the cannister is removed from the pump, the filter can be lifted out of the cannister and replaced with the new filter.

Before reinstalling the cannister and filter on the fuel pump, remove the old gasket from the fuel pump housing. Replace it with a new one.

To complete the job, screw the filter and cannister back onto the fuel pump and tighten it firmly.

Diesel cars and trucks have large filter cannisters which are mounted in the fuel line. The most common type of diesel fuel filter is a spin-on filter similar in style to an oil filter. Since the fuel system must be bled of all air after a new filter is installed, refer to the owner's manual for your vehicle. In it you will find a complete description of the procedure to follow in replacing the filter and bleeding air from the system.

DEICING LOCKS

One of the most annoying problems encountered in winter is a frozen door lock. Frozen locks can be freed by two methods. Choose the one which is most convenient.

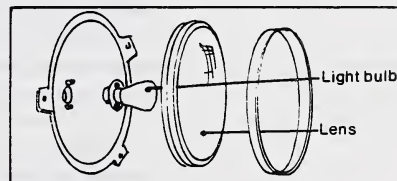
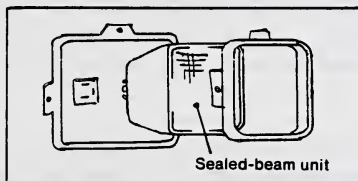
The first, and perhaps easiest method to thaw a frozen lock, is to heat the lock's key with a match or lighter and then insert it in the lock. Let the key remain in the lock for about ten seconds so heat can be transferred to unfreeze the lock. Wear gloves when doing this so as to prevent burning your fingers. If the first attempt is not successful, repeat the procedure.

The other method for deicing a lock is to use an aerosol can of lock deicer. Deicer contains a mixture of alcohol and lubricants. The alcohol dissolves the ice and frees the lock. To use lock deicer, spray it into the keyhole, wait a few seconds, and then try to unlock the door. If necessary, apply the deicer a second time.

REPLACING LIGHTS

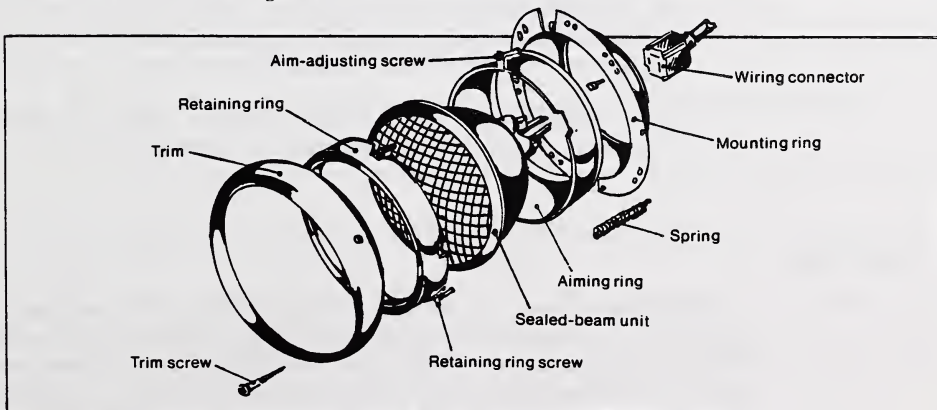
1. Headlights

Before proceeding with headlight replacement, it is necessary to purchase a replacement unit. Some headlights are sealed units, meaning the entire unit must be replaced. Other headlights (such as halogen-type headlights) need only to have the bulb replaced.



You will have to determine which type you have prior to purchasing a replacement.

To remove the headlight, first remove the three or four trim screws and remove the trim.



Next remove the retaining ring on the front of the headlight, usually three or four screws secure this. Ensure that you do not touch the two headlight-aiming screws. If you look carefully, you will be able to distinguish between the two types. The retaining screws are equally spaced on the retaining ring while the two aiming screws are further back towards the grill. One of the aiming screws will always be centred above the headlight and the other will either be centred on the left or right side of the headlight.

Once the retaining ring is removed, the headlight can be pulled forward. Unplug the wires from the rear of the headlight.

If the headlight is a sealed-beam unit, plug the wires onto the new unit and reinstall the retaining ring. Next reinstall the trim.

If the headlight is a halogen-type light with a replaceable bulb, the bulb can be pulled from the rear of the light and replaced with a new bulb. **DO NOT TOUCH THE GLASS PORTION OF THE BULB WITH YOUR FINGERS.** This will shorten the bulb life, as any deposits at all on the glass will cause overheating of the bulb.

2. Taillights

Taillights consist of one or more bulbs inside a housing. When a light is not working, the first step is to check or replace the bulb. (If you ever notice your instrument panel lights are out, check the taillights, as the same fuse is used for both of these lights.) There are two common ways to remove bulbs. Similar procedures are used for side marker lights, signal lights, and back-up light bulbs.

- (a) With the removable type of lens there are usually two screws to remove from the lens. Once the screws are removed, the lens will pull off easily. With the lens removed, the bulbs are removed by pushing inwards (very carefully) on them and turning the bulb counterclockwise approximately one-eighth turn. The bulb should now be removable. If the socket is corroded or dirty, removal may be more difficult. In this case, try wiggling the bulb back and forth as you push on it. Do this carefully since bulbs can easily break, causing cuts.

Once the bulb is removed, a new one can be installed. If the socket is corroded, scrape it clean first and lubricate the bulb and socket with petroleum jelly to prevent further corrosion. Reinstall the lens.

- (b) Most domestic cars have taillight bulbs which are accessible from the vehicle's trunk. The bulb holder clips into the sheet metal. To remove the bulb, the bulb holder is pulled forward out of the panel. Once the bulb and holder have been removed, the procedure for bulb removal and reinstallation is the same as in section (a) above.

To reinstall the bulb holder, rotate it until the tabs on the holder line up with the slots in the sheet metal panel. Then push the bulb holder into place.

3. Signal Lights

Signal lights can easily be checked to see if they are operating. The flasher unit is designed to stop operating if one (or more) bulb is burned out. If you move the turn signal lever to indicate a left or right turn and the dash light does not flash, immediately check all lights to see if one of the bulbs is burned out. This procedure will only work if the original signal flasher unit is in the car. If a heavy duty flasher is used, follow the procedure below.

A heavy duty flasher will continue to operate with a burned out bulb, therefore the signal lights must be checked visually. Turn the signal light lever to indicate a left turn and then visually check the front and rear left signal lights to make sure they are flashing. Turn the lever to indicate a right turn and visually check the front and rear right signal lights. Replace any defective bulbs.

COMPLETE THE FOLLOWING EXERCISES AND SEND THEM IN FOR CORRECTION**EXERCISE 1**

1. How often should the door hinges be lubricated on your vehicle?

2. Why should a door lock be lubricated with a silicon spray lubricant and not with ordinary oil?

3. Which portion of the windshield wiper assembly needs replacement most often?

4. What is the most likely cause of windshield wiper chattering?

5. What is the suggested maximum period of time that wiper squeegees should be used before replacement?

6. What type of fan belt is usually required to operate an electrically powered fan?

7. List four defects in a drive belt which indicate it should be replaced.

(a) _____

(b) _____

(c) _____

(d) _____

8. Explain how to test a drive belt for correct tension using your thumb.

9. Why are exhaust leaks hazardous?

10. What two ways can be used to tell whether an exhaust system leaks?

(a)

(b)

11. If you hear a loud exhaust noise under the hood of a vehicle, where is the most likely location for the leak to be?

EXERCISE 2

1. What is the purpose of a PCV valve?

2. Where is the PCV valve generally located?

3. List two checks usually done to a PCV valve to determine if it is working properly.

(a)

(b)

4. What will operating a car with a clogged air filter element likely cause?

5. How is an air cleaner element checked to see if it is dirty?

6. How often should an air filter element be replaced under normal driving conditions?

7. What could possibly happen to an air filter element if an air blow gun is held too close to the element while cleaning?

8. Why does a clutch pedal always require a certain amount of free play in it?

9. What is the purpose of the fuel filter on a vehicle?

10. Why should work on the fuel system only be done when the engine has cooled?

11. Air filters can be cleaned. Fuel filters cannot be cleaned. They are replaced. Why this difference?

12. List two ways to quickly deice a frozen door lock on a car.

(a)

(b)

13. The dash lights on your car suddenly go out. What other lights should be checked to see that they are still operating properly?

Why would you suspect these lights are not working?

14. One day you signal for a left turn and notice the signal arrow on the dash is not flashing. What should you suspect?

LESSON RECORD FORM

5039 Automobile Maintenance

Revised 88/06

FOR STUDENT USE ONLY

Date Lesson Submitted

(If label is missing
or incorrect)

File Number

Time Spent on Lesson

Lesson Number _____

FOR SCHOOL USE ONLY

Assigned
Teacher: _____

Lesson Grading: _____

Additional Grading
E/R/P Code: _____

Mark: _____

Graded by: _____

Assignment Code: _____

Date Lesson Received:

Lesson Recorded _____

Student's Questions and Comments

Apply Lesson Label Here

Name

Address

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Please verify that preprinted label is for
correct course and lesson.

Teacher's Comments:

Correspondence Teacher

ALBERTA DISTANCE LEARNING CENTRE

MAILING INSTRUCTIONS FOR CORRESPONDENCE LESSONS

1. BEFORE MAILING YOUR LESSONS, PLEASE SEE THAT:

- (1) All pages are numbered and in order, and no paper clips or staples are used.
- (2) All exercises are completed. If not, explain why.
- (3) Your work has been re-read to ensure accuracy in spelling and lesson details.
- (4) The Lesson Record Form is filled out and the correct lesson label is attached.
- (5) This mailing sheet is placed on the lesson.

2. POSTAGE REGULATIONS

Do not enclose letters with lessons.

Send all letters in a separate envelope.

3. POSTAGE RATES

First Class

Take your lesson to the Post Office and have it weighed. Attach sufficient postage and a green first-class sticker to the front of the envelope, and seal the envelope. Correspondence lessons will travel faster if first-class postage is used.

Try to mail each lesson as soon as it has been completed.

When you register for correspondence courses, you are expected to send lessons for correction regularly. Avoid sending more than two or three lessons in one subject at the same time.

GENERAL CAR CARE, ELECTRICAL SYSTEM AND PRACTICAL ACTIVITIES**Interior Car Care****Exterior Car Care****Electrical System****Practical Activities**

As you probably know, Canada has one of the roughest climates in the world for a car owner. How summers take their toll on paint as well as interior trim. Long winters with roads made harsh with ice and snow and harsher still with sand and salt, eat and grind away at a car's body.

The life of your car can be extended and its looks improved if you follow some not too complex, but important routines.

INTERIOR CAR CARE

The interior of your car can take a beating from a variety of sources. Moisture from melting snow, mud, sand, salt and possibly oil can be tracked onto the car's carpet. Drinks, food, dirt from clothing and grease can be spilt or rubbed onto the seats or the floor. Road grime can be drawn in through the heater and vents and deposited throughout the interior of the car. In addition to all this, cigarette smoke can leave tar deposits on windows. As you can see, care of the interior of a car is an important part of keeping it in showroom condition.

1. Cleaning the Carpet

The condition of a vehicle's carpet will determine the amount and type of cleaning which will be necessary. Generally, a thorough vacuuming will remove dried sand and dried loose dirt. A vacuum cleaner will remove loose food particles or crumbs as well. Do not attempt to vacuum a wet carpet or remove mud with a conventional household vacuum cleaner. While vacuuming the carpet, give the vehicle seats a quick vacuuming as well. If there is a heavy dust layer on the dash or rear window sill, vacuum it as well.

If the carpet has stains on it, two options can be tried. One option is to refer to the next section of this lesson and use the same stain removal techniques as for upholstery. The second option is to use a general carpet cleaning procedure such as listed below.

For larger stains or worked in grime (oil, pollutants, etc.), a carpet cleaning spray foam (available at most department stores) should be used. This is sprayed onto the carpet, then worked in with a damp sponge. After it has dried, it should be vacuumed. A car carpet will usually require a slightly heavier application than a house carpet. Auto carpets may also require the cleaning treatment to be done a second time.

Cigarette burns in auto carpets can be repaired. To do this, cut away the charred pile. Do not cut into the base of the carpet. Use curved cuticle-type scissors. Cut a few undamaged loops of carpet from under the seat. Fill the charred section with a glue which dries clear. Do not apply too much glue. Insert the good loops into the glue with tweezers. Make sure the loops remain fairly upright. Let the glue set. Again, only use enough glue to anchor the base of the new loops firmly.

2. Cleaning Fabric Upholstery

No matter how careful a person is, it seems that sooner or later something will be spilled on car seats. If the seats are of a cloth type, special cleaning techniques may be required. Most of these techniques can be used on carpets as well.

- (a) Chocolate candy is removed by using a cloth soaked in lukewarm water. Other candy is removed by flushing with lukewarm water. Allow the fabric to dry. If needed, rub the fabric lightly with cleaning fluid.
- (b) Coffee, fruit, ice cream, liquor and soda can be removed from fabric by wiping with a cloth soaked in cold water. If needed, you can rub lightly with cleaning fluid. You should not use soap and water as it may set the stain permanently.
- (c) Tar can be removed by scraping off the excess with a dull knife, then moisten the remaining tar with cleaning fluid and scrape lightly again. Rub lightly with more cleaning fluid.
- (d) Catsup is removed by wiping with a cloth soaked in cool water. You can use a mild detergent if more cleaning is required.
- (e) Some brands of lipstick can be removed with the use of cleaning fluid. If the stain is not removed by cleaning fluid, then leave it. Do not try anything else.
- (f) Chewing gum can be hardened with an ice cube then scraped off with a dull knife blade. Moisten with cleaning fluid and scrape again.
- (g) Butter, crayon, oil and grease can be removed by scraping off the excess and then applying cleaning fluid sparingly.
- (h) Ballpoint pen ink can usually be removed with rubbing alcohol. If a stain remains after repeated applications, do not try anything else to remove it.
- (i) Blood is best removed by using a damp cloth and cold water. Do not use soap.
- (j) To remove vomit from a cloth seat cover, sponge with a clean cloth dipped in clean, cold water. Then wash lightly with lukewarm water and mild soap. If an odor persists, treat the affected area with a solution of one teaspoon of baking soda to one cup of warm water.

3. Cleaning Vinyl or Leather Upholstery

The cause of stickiness and loss of luster on these types of upholstery is due largely to the use of polishes or cleaning preparations which injure the surface finish. To maintain a bright and clean finish on these types of upholstery the following method is suggested.

Apply damp (not wet) cloth with mild soap suds and rub the surface briskly. Next apply a moist cloth without soap. Finish by rubbing dry with a clean, soft cloth. The gloss finish of the upholstery may disappear during the first operation. However, it will be retained by the friction produced by the dry cloth.

Under no circumstances use gasolines, furniture polishes, oils or varnishes as they will harm this type of upholstery.

4. Scotchguarding

Cloth or velour fabric seatcovers can be scotchguarded to help prevent staining. It is best to scotchguard before any staining of the seatcovers occur.

Purchase Scotchguard from your local hardware store. Follow the directions on the can carefully.

5. Cleaning Windows

Windows are usually washed with warm soapy water. This will removed dirt and grime. However, the windows will appear streaky after washing.

To remove the streaks, use a glass cleaner solution sprayed onto the windows. Use paper towels to wipe thoroughly. The windows should now be shiny clean.

If by chance there is tar or other hard-to-remove compounds on the glass, you can carefully scrape these off. Do not, however, scrape on the inside of the rear window if it has a heated rear-window defogger. Scraping or using an abrasive cleaner over the heating grid will damage or destroy the rear-window defroster.

EXTERIOR CAR CARE

1. Rusting

Rust is composed mainly of iron oxide. Water from rain, dew, condensation, melted snow, etc. act as a catalyst in rust formation. Rust will proceed at a more or less constant rate once it has started. The metal will, however, only rust while it is wet.

Some automobile specialists recommend that you start exterior car care by undercoating your car, especially if it is a new one.

Undercoating is a special pliable compound which is applied to the underside of a vehicle. It should also be applied internally between panels and into those parts of the body work where acid and rust do most of their damage. An example of internal areas would be the fender joints.

Undercoating protects against acid and rust and it provides insulation against road noise.

Undercoating will do very little good unless it gets into all areas which could be affected by rust. Most rust perforations start in the least accessible areas. Unless a good job of undercoating is done, it may not prevent rusting.

Rust will appear on your car in two forms. These are exterior and interior rust.

(a) Exterior Rust

Exterior rust is easily noticed. It is crumbly and flaky and takes place on the outside of the sheet metal panels. The rust is thicker than the steel from which it formed and hence it will lift off the paint immediately around the rust spot. This will expose more steel to attack. The presence of exterior rust blisters while unsightly, are not nearly as damaging as interior rusting.

(b) Interior Rust

Interior rust begins on the inside surfaces of the steel where you have little or no access. It takes two or three years (or more) for interior (or perforation) rust to eat its way to the outside of the car body. The longer the steel is wet, the quicker it will rust. If the inside of doors stay wet for most of the winter, rapid rusting is sure to result.

One of the dangers of hidden rust is that it can weaken key areas in unitized bodies (cars without frames) and they can become unsafe without warning. Rust prevention is important for vehicles with unitized bodies.

Items such as mufflers and exhaust systems corrode from both inside and out. Road salt and moisture contribute to exterior rusting while interior rusting is caused by the water, acids, etc. in the exhaust. Most interior corrosion occurs as the car is warming up. If a vehicle's engine is shut off before it is warmed up, a residue of corrosive materials will remain in the muffler to cause rust. Once the vehicle is thoroughly warmed up, the vehicle muffler will be dry. It will remain dry even after the engine is shut off since a hot muffler will vaporize all moisture. Hence a muffler will last longer if the vehicle is always thoroughly warmed up.

2. Rust Prevention Measures

(a) Washing

One of the easiest ways to prevent rust is by removal of mud and dirt. Mud tends to hold moisture. The areas covered by a layer of mud will never dry out. As moisture leads to corrosion, a panel covered with mud will rust quickly.

Every spring after the use of salt has been discontinued, you should wash the wheel wells, bumper and other accessible areas under the body to try to remove as much salt residue and mud as possible. From time to time, especially when driving on muddy roads, the mud should be removed.

Frequent washes of the outside of the car will help to prevent exterior rust. Washing removes salt, sulphur and acid content, plus foreign matter and is necessary for the protection of the finish of a vehicle.

These damaging agents are apparent in dust or mud which may contain salt, calcium chloride, smoke-soot film, and fly ash which may contain sulphur, saps from various types of trees, and rain drops or dew from trees that have been sprayed with a spray containing acid. Any of these, if permitted to remain on the finish, will either discolor or cause blisters in any type of paint.

To avoid scratching the finish, the car should be washed rather than cleaned with a dry cloth. Wash the car only when it is out of the rays of the sun and after the metal surface has been allowed to cool. Use cool water and dry with a clean chamois.

(b) Undercoating

Controversy exists as to the benefit of antirust treatments such as undercoating. A study by the Quebec Auto Club in 1978 showed that after a 5-year period, the sprayed-on conventional tar undercoats reduced the number of rust holes by only one-third.

This study also showed that the best rust prevention treatment (and least expensive) is to spray oil or grease onto the clean underside of the car body and into hard-to-reach areas such as the inside of doors and wheel wells. Oil will seep into inaccessible area much better than conventional undercoats. Oil works on the principle that oil and water do not mix. The oil coats the surface of the metal and prevents water from contacting the metal. If the metal cannot get wet, it will not rust.

The car owner can do a simpler, more basic treatment himself (without spray equipment). This will help prevent rust in some areas.

To apply oil yourself, you will need a plunger-type oil can of SAE30 motor oil. The oil can be squirted into the following areas which tend to rust quickly. These are:

- the inside of doors;
- the door posts;
- the rocker panels;
- the fenders;
- the corners of the trunk;
- the trunk deck and hood;
- the frame;
- under the floor and trunk mats;
- under the car.

Oil sprayed privately by a garage may cost from to \$25 to \$50 depending on the thoroughness of the job.

Grease may be used as a treatment as well. Special grease products for this use are available from major oil companies. Grease must be applied at a garage using an air compressor. An application of grease is claimed to be effective for up to five years on a car.

There are, however, disadvantages to oil and grease treatments. Applying oil or grease may void conventional custom antirust treatments. Applying oil may also soften parts made of plastic or foam rubber. Damage to radio speakers in doors could result. As oil and grease are flammable, they can contribute to a hazardous fire situation especially if body work is done using a welder or grinder. Other problems can include a messy driveway or garage floor, stained clothes, plus other environmental damage.

3. Trim and Paint Care

(a) Washing

Thorough washing has already been discussed under rust protection.

(b) Bug Removal

This can be quite a serious problem. Some bug residues are nearly impossible to remove. Chemicals of various types are available which will aid in the easy removal of bugs.

(c) Tar Removal

Tar is very difficult to remove unless a solvent-based cleaner is used. Gasoline is not recommended, as it is extremely flammable and may harm the paint as well. Chemicals are available at auto parts stores to aid in the removal of tar.

(d) Waxing

In order to keep a shiny, showroom appearance on a vehicle's body, waxing at least once a year is recommended. Waxing not only improves appearance considerably, it also protects small defects in the painted surface from enlarging and decreases the chance of exterior rust formation.

(e) Touch-Up Paint

Rock chips, as well as parking lot dents and chips, should be repaired before rust begins. Touch-up paint is available at most auto parts stores. Before applying touch-up paint, all loose flakes of paint should be removed from the panel surface and the area thoroughly cleaned. Follow the directions on the can of touch-up paint for best results.

ELECTRICAL SYSTEM**1. Battery**

(a) Safety

Batteries can be dangerous.

The battery electrolyte contains about 38% (when fully charged) sulphuric acid and as such can cause serious skin and eye burns.

Below is a chart containing information on what to do if battery electrolyte is spilled.

Electrolyte spilled on:	Counteracted by:
skin	flushing with large quantities of cold water.
eyes	flushing with large quantities of cold water, then contact a doctor.
clothing	flushing with large quantities of cold water, then wash with a solution of baking soda and water.
metals	same as for clothing.

To avoid accidents try to follow these safety rules.

- (i) Wear rubber gloves and goggles when handling electrolyte.
- (ii) When mixing acid and water, **ALWAYS ADD THE ACID TO THE WATER.** Do this slowly and stir constantly.
- (iii) **NEVER** allow any type of open flame near a battery. The mixture of hydrogen and oxygen given off is very explosive and will shatter the battery case, spraying acid over a wide area.

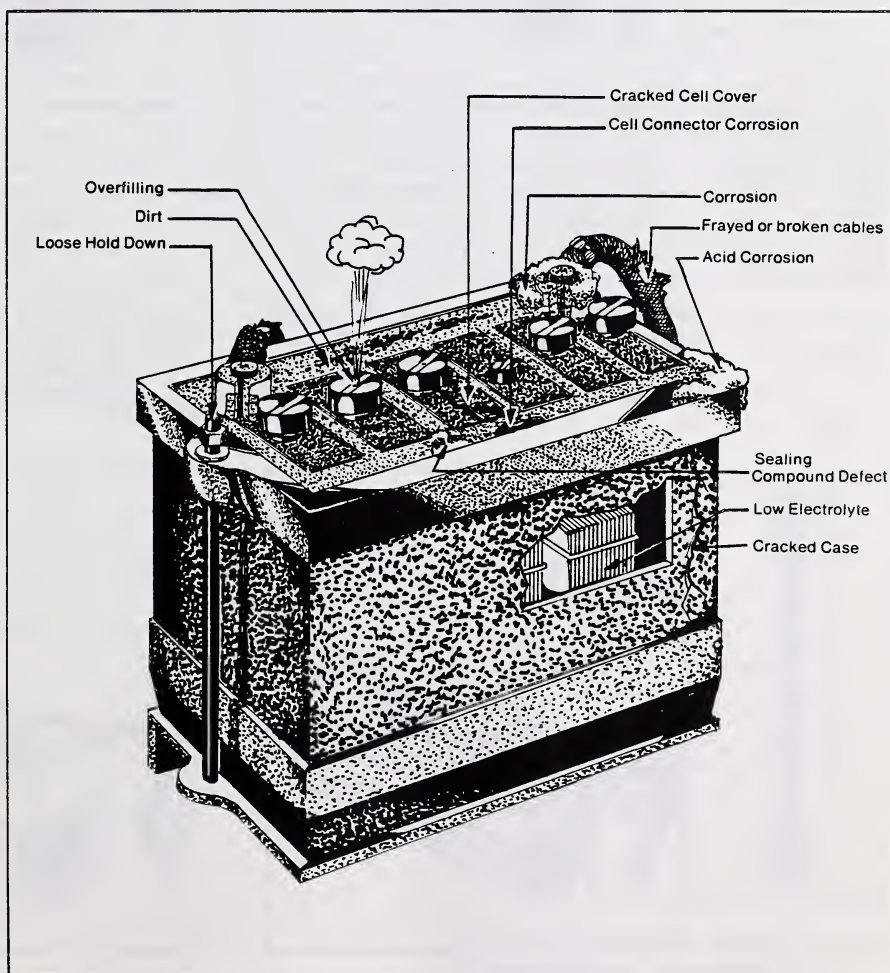
- (iv) Always lift and carry batteries with a properly fitted carrying strap.
- (v) When a battery is not in the car, place it carefully where it cannot become exposed to excessive cold or heat, open flames or be banged or knocked over.

(b) Checking the Battery Visually and Cleaning

Examine the battery for signs of corrosion, cracking and leakage. Also inspect the hold-down, terminals, cables and electrolyte level.

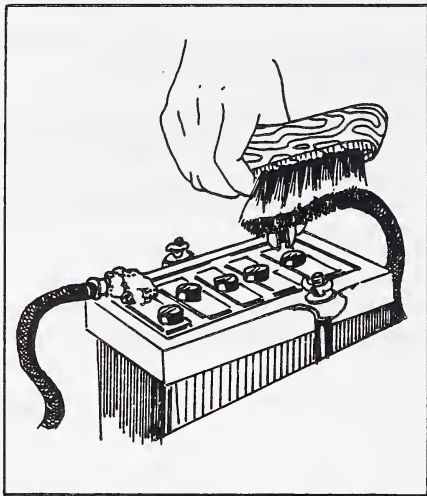
Remove all corrosion: Small leaks and gassing (formation of H_2 and O_2 gases while charging) eventually attack the battery terminals. Unless removed periodically, this corrosion will eat the material of the posts and terminals. This also imparts a high resistance to current flow.

VISUAL BATTERY CHECKS

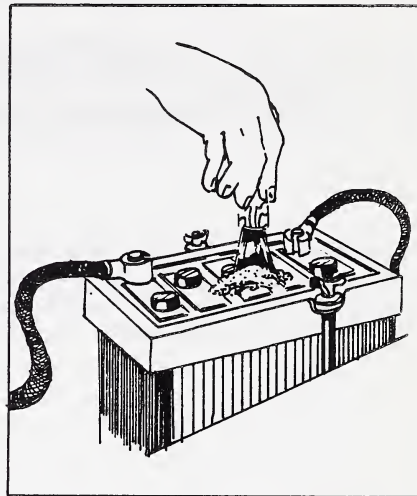


A

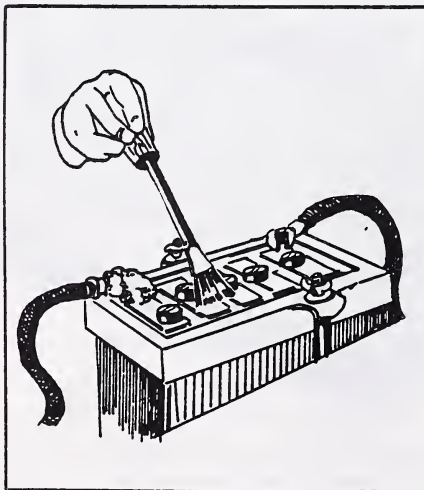
Use a wire brush and clean away the bulk of the corrosion from the battery and terminals.

**B**

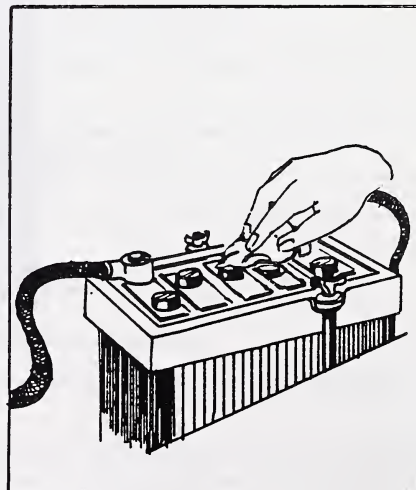
Brush on a solution of baking soda and water. **DO NOT ALLOW ANY TO GET INTO THE BATTERY.**

**C**

After the foaming action has stopped, apply a fresh solution to the badly corroded areas then rinse thoroughly with clean water.

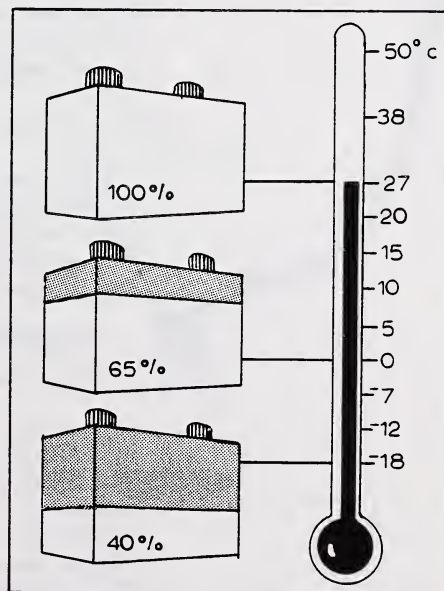
**D**

Wipe all surfaces dry and use a battery post brush to clean the terminals and posts. Install and tighten securely then coat with a good **NON-METALLIC** grease.



A dirty (or wet) battery top will attract electrolyte and thus become a conductor which will allow a small trickle of current between the posts, causing a slow discharge situation. The battery hold-down must be snug to stop movement of the battery, but be sure that it is not tight enough to cause damage. There are some special spray products on the market which can be used on the hold-down bolts and tray to prevent corrosion. Always check the electrolyte level in each cell. Most batteries have an indicator (i.e. a slot, notch, lip, etc.) which shows where the electrolyte should be. If there is no indicator, then keep the level about 1 cm above the separators. **AVOID OVERFILLING**, as this causes expansion pressure, overflowing, and therefore, excessive corrosion. If the battery needs topping up often, the charging system should be checked, as this is a major symptom of overcharging which will drastically reduce the life of the battery.

Always use **DISTILLED WATER** because most tap water has a high mineral content which is harmful to the battery. A fully charged battery usually has about 62% H_2O in it and the remainder is sulphuric acid at this time. The relative density reading will be 1.225 to 1.280 depending on the climatic conditions with the lower number being the reading in a tropical climate. A half-charged battery will be about 80% H_2O and have a reading of 1.135 to 1.180 with the larger number being found in northern climates. A dead battery will usually read about 1.080 or lower in the relative density test. If, when testing the battery, the highest reading obtained is below 1.190, then the battery should be charged by an external means and then retested. If there is a difference of more than 0.025 points between any cells of the battery, it should be checked by a professional with the correct equipment. The proper tool for these relative density tests is a **hydrometer** and remember **NEVER** top up the battery before taking your readings. If the battery is too low to obtain electrolyte for the reading, then top it up and run the car for a considerable period of time to completely mix the solution before taking your reading. Fill the hydrometer three or four times and resquirt the solution back into the battery before taking your reading so that the interior float is up to the correct temperature of the electrolyte. Note the temperature of the electrolyte and adjust the relative density reading accordingly. The adjustment to be used, is for each 10° that the temperature is above $26^\circ C$ you **ADD** 0.008 points to the reading obtained. For each 10° that the temperature is below $27^\circ C$, you **SUBTRACT** 0.008 points from the reading. Therefore, if the temperature of the electrolyte is between $25 - 30^\circ C$, you accept the reading given on the hydrometer float. Cold weather is very hard on a battery and the following diagram depicts the efficiency of a fully-charged battery at different temperatures.



Capacities at indicated temperatures are for sound batteries, fully charged only.

(c) Battery Charging

If a battery has less than a 75% charge then it should be recharged by an outside source. There are two ways that this can be done, that is, by slow charging or fast charging. Also, if the battery is low on charge, check to see what is causing the problem. If the relative density reading of the cells are not all within a maximum spread of 0.025 points, the the problem could be an internal one, i.e. warped plates, excessive dirt, etc., otherwise check the regulator, generator, or consider if there has been excessive cranking or a drainage of current by an electrical device being left on or a short which is draining the charge. When charging a battery, what you are doing is reversing the chemical process in the battery, which increases the amount of sulphuric acid in the solution.

(i) Slow Charging

This method passes a relatively small amount (5 A to 7 A) of current through the battery over a long period of time (14 h to 16 h or longer). Slow charging is preferred to fast charging if the time is available, however, a sound battery will not be damaged by **PROPER** fast charging. Since the exact battery cell condition is not always known, the slow-charging method reduces risk of damage. Seven percent of the rated ampere-hour capacity of the battery is considered the maximum for a slow charge. If you are not sure of the battery-rating, charge at about 5 A to be on the safe side.

Clean and top up the battery before beginning the charge, then disconnect at least one of the connecting cables from the battery before charging, to prevent damage to electrical units. This is necessary in case the charger is hooked up backwards. **NO** matter what grounding system is used in your car, you always connect the positive (+) lead of the charger to the positive post and the negative (-) lead to the negative post. During charging, check the relative density periodically and if it remains unchanged over a period of three hours, or it reaches a full charge reading, then the charging should be discontinued. Remember, overcharging is very hard on the battery. Also watch the temperature of the electrolyte and never let it exceed a maximum of 50°C or serious damage will result in the battery.

(ii) Fast Charging

The fast-charge method sends a relatively heavy initial current through the battery (about 50 A to 60 A for 12V batteries), which imparts a fairly good charge in a short time (1 h to 2 h). You prepare the battery as directed under slow charge, then hook the positive lead of the charger to the positive post and the negative lead to the negative post.

DANGER!! ALWAYS DISCONNECT THE BATTERY CABLES FIRST

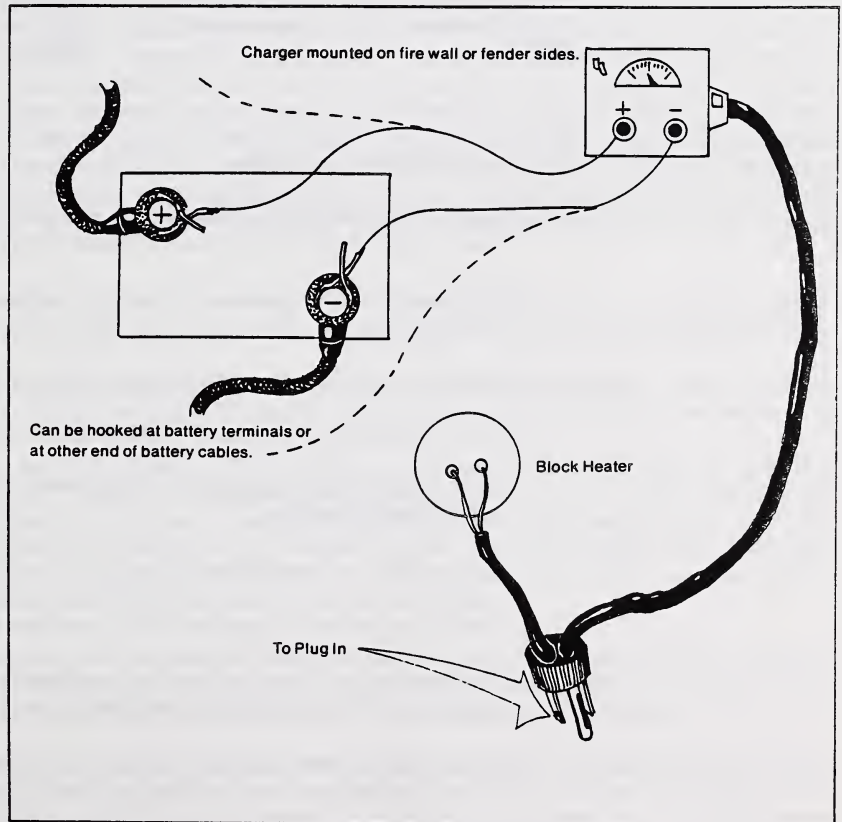
Never fast-charge a battery that is connected to the car's electrical system.

Set the current controls as required depending on the charger used and battery to be charged. Switch to 6 V or 12 V depending on battery, then turn the charger on. Be very sure not to have an excess of electrolyte in the battery because fast charging causes considerable expansion (electrolyte should even be slightly low) and can be topped up when charging is completed. Usually, the charger automatically reduces the rate of charge as the battery charge increases. This depends on the type of charger you have. The fast-charge method does **NOT** bring a battery to full charge. If full charge is required, remove the charger when the battery is three-quarters charged and finish charging with the slow-charge method.

Watch the battery temperature closely and if it reaches a temperature of 45°C , lower the rate to slow charge at once. If the readings of the electrolyte do not change over a one-hour period, then discontinue fast charge. You can then try a slow charge to see if the battery will accept any more charge.

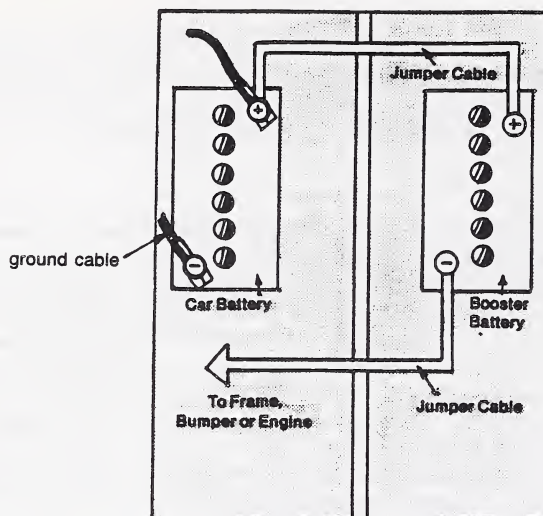
(iii) Trickle Charging

This is the method which is best for our climate. There are many types of reasonable trickle chargers on the market and one can be mounted permanently in the car with very little effort. The trickle charger passes a very low current, often less than one amp, through the battery. It is best to get a trickle charger with an automatic kick-out in it which will discontinue the charging process when the battery is charged. Even this small amount of current can damage an overcharged battery. During cold-weather operation, it is even more important to keep the battery in good condition than many other parts of the car. We usually plug in a block heater of some type when the automobile is not in use. So if a trickle charger is mounted in the car and wired to the battery and block heater, the battery can also be kept in good shape. It is **NOT** necessary to disconnect any electrical units when using a trickle charger.

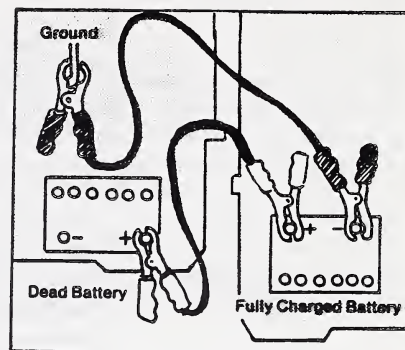


(d) Boosting

The use of jumper cables to boost a car whose battery does not have enough energy to start it, is a form of fast-charging. It should be done very carefully and never to a completely dead or frozen battery because it could explode. The following twelve steps should be followed when boosting a car that has a negative grounding system only.



Connect jumper cables so that the correct battery polarity will be maintained (positive to positive, negative to negative).



Safe battery boost

To boost a dead battery, move the vehicles close together but don't allow the bumpers to touch. Attach one end of the red jumper cable to the positive post of the dead battery, and attach the other end to the positive post of the boost battery. Connect the black cable to the boost battery's negative post, the other end to the block of the car to be started. This prevents a spark from igniting battery gases.

Before connecting jumper cables:

- (i) Check fluid level in the cells. If frozen or the battery has no spark (life), then thaw or slow charge. Never boost a dead or frozen battery, it may explode.
- (ii) Make sure both batteries are of the same voltage, never boost if one is a 6 V and one is a 12 V.
- (iii) Position vehicles conveniently close but **NOT** touching.
- (iv) Turn off all accessories in both vehicles, lights, radios, etc.

NOW YOU CAN CONNECT THE JUMPER CABLES FOLLOWING THESE ADDITIONAL RULES:

- (v) Connect the two positive posts together. These are usually marked "P," "+," or painted red on top or near the post. If none of these are there, then remember that the positive post is usually a little larger than the negative post.
- (vi) Connect the other jumper cable to the negative post of the booster battery (the operational car). This post is often identified by an "N," "-", or black paint.
- (vii) Connect the other end of this cable to a clean, unpainted portion of the frame, bumper, or engine. A good metal ground area is necessary.
- (viii) **DO NOT CONNECT TO THE DISABLED BATTERY.** Sparks may occur during this final connection and hydrogen gas, that could be near the caps of the battery, is highly explosive.
- (ix) Check to see that all connections are secure and that they cannot touch each other or connect with moving engine parts like fan or fan belt, etc.

- (x) Now start the engine of the vehicle that is supplying the boost.
- (xi) Only now should you attempt to start the disabled vehicle. **DO NOT** hold the key for very long. Turn it over for short periods of time only, until it starts or does not start. If it does not start in a few tries, then something besides a poor battery is the matter.
- (xii) **CAUTION**, once started, jumper cables can get extremely hot. Remove with car in the exact reverse sequence to the way you connected them.

If you are not sure of the polarity or condition of the battery, to be on the safe side, disconnect the cable from the battery of the disabled car that **DOES NOT HOOK** to the frame or metal of the engine. This cable is usually covered and hooks to an electrical unit like the solenoid or starter. Then connect the booster battery to the car following the rules of positive to positive and negative to negative, but hook to this disconnected cable, **NOT** the battery post. You may follow the steps previously given if you are now bypassing the disabled battery.

2. Regulator

The generator-regulator system is important in that it maintains the battery in proper working condition. Periodic reservicing, such as belt tension, is usually all that is required for many kilometres of operation. Most of the later model automobiles do not require lubrication of the alternator because they have sealed bearings. This lubrication though, is advisable on older models. However, normal wear over an extended period, part breakage, part failure, service incurred damage, etc., may result in the system due to such things as overcharging, undercharging, or no charge. Many problems in the battery-generator (or alternator-regulator) system start out as minor and gradually become worse. The fact that a problem exists is the system may become known in a number of ways without conducting tests with special equipment.

Short light bulb life and frequent addition of battery water are two very common indications of overcharging. This is very costly if not corrected in time as it may damage the battery.

Slow cranking, dim headlights, and a battery that never needs addition of fluid is a strong indication of undercharging. This is also serious, but not quite as bad as overcharging is.

If you are lucky enough to have a gauge in your car rather than a warning light, then you can nearly always see small problems before they get out of hand. There is a problem that needs looking into if the ammeter continually indicates a high rate of charge, especially if driving during the daytime with no major electrical units in operation. Also if the meter reads low or no charge just after starting the vehicle, especially in colder weather, there is a problem.

If you only have an indicator light, this should always be off when the key is off and on when the key is on, but the engine is not running. Once the engine is running the light should go out. Performance different from this indicates system problems.

Both types of generators (DC and AC) should run quietly. A whining noise in an alternator usually indicates a faulty diode, while a general noisy condition will indicate an in-operative diode which is causing an electrical imbalance. A squealing sound usually indicates a loose or glazed belt which requires tightening. If the sound persists, the belt should be deglazed (roughened). If a howl is heard from a DC generator, it usually indicates a rough, out-of-round commutator. Dry or worn bearings and loose pulleys usually result in a clicking, squealing or growling sound in both types of generators.

Before you ever start a series of time-consuming tests or remove parts for examination and repair, be sure to give the system a complete inspection. Look for belt tension, loose connections, dirty connections, burned or frayed wires, and other physical damage to units of the system.

Always check the battery condition first before condemning other parts of the system. A fully charged battery is a must for the system to operate properly.

A worn or sulphated battery will produce many problems that will inadvertently be blamed on other units of the system. Also remember that if a unit of the system needs replacing, then something in the system caused this. DO NOT just replace the unit without repairing whatever caused the problem or the replaced unit will just fail again. For a more indepth study, check a repair manual for your specific make and model of vehicle.

Do not attempt to adjust a regulator unless its operation is thoroughly understood and accurate meters are available. Even a slight error in the setting of this unit may cause improper functioning, resulting in an overcharged or run-down battery. Also, damage to the charging unit and regulator can occur. A good service manual for the make and model of vehicle is also a must because of the many different types of regulators in use.

3. Cranking System

When trouble develops in the starting motor circuit, and the starter cranks the engine slowly or not at all, there are several preliminary checks that can be made. First you wish to determine where the problem lies: in the starter, battery, controls, wiring, etc. Many conditions besides defects in the starter itself can result in poor cranking performance. First check the battery, then connections and wiring for looseness, corrosion, and frayed or burned places.

To make a quick check of the starter system, turn on the headlights. They should burn with normal brilliance. If they do not, then the problem is probably in the battery (which could be run down and needs checking with a hydrometer). If the battery is in a good charged condition, the lights will be bright. Now operate the ignition key to turn the starter motor over. Any one of three things should happen.

- (a) The lights go out.
- (b) The lights dim considerably.
- (c) The lights remain bright with no dimming.

Under normal operations they will dim a certain extent.

- (a) If the lights go out:

When you close the starter switch and the lights go out, it indicates that there is a poor connection between the battery and the starting motor. This poor connection is usually found at the battery terminals. Correction is made by removing the cable clamps from the terminals, cleaning the clamps and terminals, and then replacing them securely. A coating of corrosion inhibitor (such as vaseline or grease) may be applied over the posts and clamps to retard the formation of corrosion. If the problem is not cured then check, clean, and tighten the other ends of the cables. If by chance this does not cure the problem, then replace the cables or have the circuit checked with the correct meters.

(b) If the lights dim considerably:

When you close the starter switch and the lights dim a great amount, the starter motor (if you listen to it) is probably turning very slowly or not at all. First check the battery. It may be in a run-down condition. There could also be a mechanical condition in the starter such as a faulty starter drive or worn bushings which would mean an extra load on the starter. This would cause a very high current draw by the starter which means the headlights would dim. As mentioned earlier, check the **BATTERY FIRST**. If it is fully charged or at least above the 75% charge, then the problem lies in the engine or starter motor.

In the engine, tight bearings, pistons, or heavy oils can place an added strain on the starter. Low temperatures also hamper starting motor performance since it thickens the oil and makes cranking much more difficult. In the starting motor there could be any number of problems: a bent armature shaft, loose pole screw, worn bearings, etc.

In addition to the items mentioned above, there could be other serious problems such as thrown armature windings or commutator bars, etc. These are usually caused by a person keeping the starter circuit closed after the engine has started or racing the engine at too high of a speed while starter is still engaged (too much throttle).

Another cause of problems may be engine backfiring during cranking. This is caused, among other things, from the ignition being too far advanced. To avoid such failures, the driver should pause a few seconds after each unsuccessful attempt at starting to make sure that the engine has totally stopped its rotation, before another attempt at starting is made. In addition, the ignition timing should be re-calibrated if engine backfiring has resulted during the starting operation.

(c) Lights bright and NO cranking:

This condition indicates a broken (open) circuit somewhere in the cranking (starting) system. The main wire lead from the battery usually goes to a solenoid switch and from here to the starter motor. If you encounter the above type of problem, use a jumper cable to bypass the solenoid switch and connect the starter momentarily to a direct circuit. If the cranking motor now turns, then remove the solenoid switch for inspection.

FIRST CHECK ALL CONNECTIONS AND WIRES.

If the motor does not operate, then the open circuit is inside the cranking motor and it will have to be removed from the vehicle for further testing. All tests beyond this point require special equipment such as voltmeters, ammeters, a dial indicator, micrometer, and ground tester (i.e. test lamp).

PRACTICAL ACTIVITIES

This portion of the lesson involves doing practical work on a vehicle. In order to complete it, you will require the supervision of someone knowledgeable in the field of vehicle maintenance and repair (such as a qualified journeyman mechanic or a certified mechanics or automotives teacher). The supervisor must be willing to supervise your work, to outline safe procedures and tool use, and to demonstrate desired methods. Also, the supervisor must give a signed evaluation of your work.

You will require access to a vehicle for this section. Use the same vehicle throughout the practical work activity. One of the activities involves doing an engine oil change. Try to arrange the practical work so the oil change comes at the correct time or mileage period for the vehicle.

Complete the following practical assignment and questions and send them in for correction.

EXERCISE 1 Vehicle Specifications

Vehicle (Make, Model and Year)

Engine type (gasoline, diesel; 4 cylinder, slant 6, 8)

Engine size (2.1 L, 5.5 L, 7 L, etc.)

Primary Use (carrying passengers, hauling loads, etc.)

Odometer Reading (km) _____

Obtain the following information from the owner's manual or an automotive dealer.

Recommended maintenance intervals [in time, distance (km), or both]

Oil and filter change _____

Chassis lubrication _____

Coolant replacement _____

Tire pressure check _____

Notes of Repairs Necessary

- [illegible]

[illegible]

EXERCISE 3, 4 and 5: Lubrication System, Battery and Charging System, Steering System**STUDENT**

Name: _____

File Number: _____

SUPERVISOR

Name: _____

Home Address: _____

Work Address: _____

Phone Numbers: _____ Home _____ Work

Occupation: _____

VEHICLE

Make, Model and Year of Vehicle:

Engine Type: _____

Engine Size: _____

Odometer Reading: _____

Type of Transmission (Automatic or Manual): _____

Type of Steering System (Manual or Power): _____

Complete the activities indicated, and fill in the required information. Enter a check mark (✓) in the second column as you complete each activity or become familiarized with the component named. If the activity is not applicable because of different system components, please indicate that in the "Answers or Comments" column. Write answers to the questions or comments concerning component conditions in the third column.

Lubrication System

Activity	Check	Answers or Comments
Check the engine oil dipstick. What is the engine oil level? What is the engine oil condition?		
Check the condition of oil pressure guage lines (if a guage is used).		
Inspection for leaks Is there any evidence of engine oil leaks? If so, what is the source of the leak(s)?		
Oil and filter change Change the oil and filter of the vehicle. What brand and type of oil is used? How much? What type of filter is used (brand and part number)?		
Chassis lubrication Complete a chassis lubrication (grease job). How many lubrication points are there? What are the conditions of the seals?		
Check the differential fluid level. Is it correct? Where is the oil level plug located?		
Check the transmission fluid (for automatics). What is the level when cold? What is the level when hot? Where is the level checked? Feel and smell some of the fluid to test it for any grittiness and/or burnt odor.		

Battery and Charging System

Activity	Check	Answers or Comments
<p>Battery</p> <p>What type of battery is used (is it a "maintenance free" type)?</p> <p>How many cells does it have?</p> <p>What are the conditions of the battery cables (loose connection, frayed insulation, broken connection or insulation)?</p> <p>Are the battery terminals and cable connectors free of corrosion?</p> <p>Are the battery case and cell covers cracked or dirty?</p> <p>Remove cables from the battery, clean and lightly grease terminal posts and the cable connectors.</p> <p>If necessary, replace cables or cable connectors.</p> <p>Check the electrolyte level in each cell.</p> <p>Measure and give the specific gravity or relative density readings for the electrolyte in each cell, using a hydrometer.</p> <p>Examine the battery tie-down clamps (is the battery held firmly in position?)</p>		
<p>Generator/Alternator</p> <p>Is a generator or alternator used?</p> <p>What is the make and model?</p> <p>Examine the belt.</p> <p>Is it in good condition?</p> <p>Is the belt tension correct?</p> <p>Are there any broken, frayed or loose connections?</p>		

Steering System, Wheels and Tires

Activity	Check	Answers or Comments
Steering What type of steering system (power or manual) is used? Where is the power steering fluid checked?		
Tires What type of tire is used (bias-ply, belted, radial)? Are there wear spots at any points on the tread of any tire? Is there evidence of punctures? Is there any evidence of damage and scuffing of the sidewalls? Remove foreign items lodged between treads (small stones, etc.). Measure and give the tread depth for each tire. What proportion of tread remains for each tire? Measure and give tire air pressure for all tires. What are the recommended tire pressure values? What are the conditions of the valves and valve stems? Are there valve caps on all valves?		
Examine and indicate the rim condition.		
Is there any evidence of need for wheel alignment and balancing - if so, what is the evidence?		

TO BE COMPLETED BY THE SUPERVISOR

Supervisor's overall evaluation of the student's work for this activity (check one):

Excellent

☐

Very Good

☐

Good

☐

Fair

☐

Poor

☐

Supervisor's comments concerning the student's work.

Supervisor's Signature: _____

Date: _____

EXERCISE 6

1. A carpet has been dirtied by many years of use. Explain how to **thoroughly** clean it.

2. What must be present in order for rusting to occur on a vehicle?

3. Why does paint tend to peel off around rusted areas?

4. Why do some car mufflers last longer than others even though they are on the same model of car?

5. Why is the application of oil to a surface considered a good antirust treatment?

6. What will happen to your clothes if battery acid is accidentally wiped onto them?

7. Why is it important to clean the top of the battery from time to time?

8. Why is distilled water recommended when refilling batteries?

9. Why is a trickle battery charger best for use considering Alberta weather conditions?

10. Why should a frozen battery never be boosted?

11. The first booster cable connects to the positive post of both batteries. The second cable is attached from the negative terminal of the booster battery to a ground point on the vehicle being boosted. Why is this second cable not attached to the battery terminal, but instead to a ground point on the vehicle such as the bumper or engine block?

12. What are two indications that a regulator is faulty?

(a)

(b)

13. When the key on a car is turned to the start position, a click is heard under the hood, then nothing. What procedure would you follow to check and see what is wrong?

What would the problem likely be if the lights dim or go out when the key was turned to the start position?

14. How is antifreeze strength determined?

15. What would the problem likely be if the lights go out when the key was turned to the start position?

16. What will happen if drive belt tension is excessive?
